CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter presents the environmental consequences to the proposed Provo Canyon Highway Improvement Project Area (Project Area) and the proposed Trail Extension project. This chapter is organized in three parts:

- Highway Reconstruction - Wildwood to Deer Creek State Park
- Highway Reconstruction - Deer Creek State Park to Heber City
- Trail Extension

Potential direct and indirect impacts are discussed below under each potentially affected resource component. Potential cumulative effects are disclosed in the Cumulative Effects section of this chapter. Impacts described in this chapter are based on preliminary design of the alternatives under consideration. During final design, efforts will be made to reduce these impacts to the greatest extent practicable. The No Build alternative has been used as a baseline for analysis in all impact categories. The impacts of the No Build alternative are summarized in the Combined Considerations section of this chapter.

HIGHWAY RECONSTRUCTION - WILDWOOD TO DEER CREEK STATE PARK

The section compares the environmental consequences of two alternatives for the Wildwood to Deer Creek State Park Segment – the "1989 SEIS Alignment" and the "2002 Preferred Alignment." In general, as explained below, the 2002 Preferred Alignment causes fewer impacts than the 1989 SEIS Alignment. There are two areas in which the 2002 Preferred Alignment would cause greater impacts than the 1989 SEIS Alignment – specifically, the Canyon Meadows development and the Deer Creek Dam Complex. In each of those areas, the impacts of the Project have been mitigated, as further explained below.

As noted in Chapter 2, a haul road already exists along a portion of the alignment for the Wildwood to Deer Creek State Park Segment. This haul road was built during the construction of the Upper Falls to Wildwood Segment, in order to transport excess fill material generated by the construction of that segment. See Figure 5-26. As a result of the construction of the haul road, some of the impacts described in this chapter have already occurred.

Earth Resources

The proposed alignment and widening would necessitate new cuts and embankments requiring special construction considerations to address known geologic complexities and hazards. Previous experience from the highway improvements made down-canyon of Wildwood, as well as slide repairs and maintenance in the Hoover Slide area, provided valuable insights during development of the 2002 Preferred Alignment. Although there are certainly geotechnical issues associated with both the 1989 SEIS and 2002 Preferred Alignments, an independent geotechnical peer review of the 2002 Preferred Alignment deemed it "reasonable and feasible." Additionally, analysis showed that the effort to maintain stability along the 2002 Preferred Alignment appears to be less costly and less risky when compared with the 1989 SEIS Alignment (Table 4-1) (Landslide Technology 2001).

Table 4-1. Lengths of Active Slides Crossed by the 1989 SEIS and 2002 Preferred Alignments.

1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
700 meters (2,300 feet)	200 Meters (650 feet)

Source: Landslide Technology (2001).

Difficult geotechnical issues for the 2002 Preferred Alignment include ramping up the west flank of the Hoover Slide area, large cut slopes in the saddle area, fills in wet areas, large cuts upstream of the dam, blue mud, the area adjacent to the construction slide, finishing the construction slide, and excavation cuts downslope of Canyon Meadows. The total length of active slides crossed or potentially impacted by the 2002 Preferred Alignment would be less than 200 meters (650 feet) at all locations (Landslide Technology 2001).

Difficult geotechnical issues for the 1989 SEIS Alignment would include potential impacts to the Provo River, cuts and fills near Horseshoe Bend, rockfall concerns in the area of the exposed block of fractured Oquirrh Limestone (existing and with new cut slopes), large cuts upstream of the dam, blue mud, the area adjacent to the construction slide, finishing the construction slide, excavation cuts downslope of Canyon Meadows, fills in active slide areas, stability of retaining walls in active slide areas, and mitigation of active slides affecting the roadway. The total length of existing roadway currently impacted by active slides would be about 700 meters (2,300 feet) and would remain the same under the 1989 SEIS Alignment (Landslide Technology 2001).

Water Resources

Water resources in the Project Area would not be impacted, other than potential water quality effects. As discussed below, a detailed water quality analysis suggests that with appropriate Best Management Practices (BMPs), the Project will result in an improvement in water quality over the existing condition.

Water Quality

The majority of the water resource impacts presented in the 1989 SEIS remain as concerns today, and the mitigation recommended would be implemented as part of the Project.

The 1989 SEIS (FHWA 1989a) included a comprehensive examination of current water quality. Data from seven sampling stations in the reservoir and along the river were used to determine existing water quality in the area. Only years 1985 to 1988 were used and reviewed for pollutants including heavy metals, pH, turbidity, nitrates, and phosphates (Howard et al. 1989). To determine if the water was exceeding its numerical criteria, an average of all the data was compared with the state standard developed for each section of the reservoir and river in the Project Area (Howard et al. 1989). This analysis showed that only phosphates were exceeding the water quality standard. They note that agricultural runoff has historically played a major role in the levels of phosphate entering the water body.

The SEIS (FHWA 1989a) identifies several potential pollution sources. These are storm water runoff, point sources, soil erosion, animals, and recreational use. The SEIS (FHWA 1989a) states that light rainfall will infiltrate pervious surfaces. Highway runoff is a problem only during storms heavy enough to generate runoff that must be directed into ditches. The road will also increase impervious area in the watershed, further affecting the quality and quantity of runoff.

The 1989 SEIS modeling of potential pollution from highway sources is based on research that found that overall quality of runoff from highways may be correlated to total suspended solids (TSS). Thus, projected traffic volumes for 2010, and differences in construction and truck usage were used to predict loads of the other pollutants. These loads were compared to existing loads in the Provo River (Howard et al. 1989).

The modeled results provided a general analysis of water resource impacts, including an analysis of heavy metals and other important constituents. Pollutants considered in the analysis were TSS, lead, zinc, copper, nitrate/nitrite, and total phosphorus in Provo River, and TSS, lead, zinc, iron, copper, cadmium, and mercury in Deer Creek Reservoir. The SEIS (FHWA 1989a) found that, relative to the entire watershed, the impacts would be minimal. The reduction in pollutant loads with implementation of vegetated drainage ditches as BMPs was also analyzed in the report (Howard et al. 1989). The vegetated swales were vital to managing pollutant loads from the road.

Other mitigation measures during construction and operation of the highway are listed in the SEIS. These include using clear-span bridges to avoid disturbance in the river channel and retaining walls to prevent soil losses from fill slopes and decrease the total amount of soil susceptible to erosion. The river channel relocation BMPs include features to restrict streambed erosion. Drop structures will help trap sediment and water. Irrigation diversion facilities can also serve to trap sediment. Coupled with vegetated swales, the SEIS found that BMPs mitigated the impacts from erosion such that neither construction nor operation increased the concentration of sediment into the river (FHWA 1989a). The SEIS also states that "every possible measure will be taken to direct runoff at construction areas from entering Provo River and Deer Creek Reservoir" (FHWA 1989a).

Chloride concentrations from increased use of de-icing salts were also analyzed in the 1989 SEIS. The analysis indicates a chloride concentration of 2.5 to 5.0 milligrams per liter (mg/L) during winter low flows, well below the maximum concentrations of 12 to 20 mg/L in the river and 11 to 15 mg/L in the reservoir. The estimated salt input from road application is based on the assumption that most snow melts within a few days, so each runoff event carries only the chloride present from the application of salt to the road during an individual storm. However, Howard et al. (1989) also state that spring runoff carries winter deicing salts to Provo River and Deer Creek Reservoir. A U.S. Geological Survey (USGS) method used in the analysis found an increase of 1.0 mg/L above the current levels, which would have no detrimental effect on water quality (Howard et al. 1989).

The report (FHWA 1989a) notes that roll-over accidents caused by sharp curves cause some spill-related pollution. The highway realignment may reduce the potential for these accidents and subsequent pollution (FHWA 1989a).

Water quality levels and concerns were again examined during development of the Provo River Watershed Management Plan (BIO-WEST et al. 2000) and also during this analysis. No significant changes in water quality were noted.

Utah Non-point Source Pollution Management Plan

The Utah Non-point Source Pollution Management Plan (UTNPS Plan) (DEQ 2000) lists goals and objectives for reducing non-point source pollution in the state of Utah. Of the objectives listed in the UTNPS Plan, environmental protection is the most pertinent to this Project. Goals under this objective are as follows:

- to conserve the waters of the state;
- to protect, maintain, and improve the quality of waters of the state for designated beneficial uses; and
- to provide for the prevention, abatement, and control of new or existing sources of polluted runoff.

The goals most relevant to road construction activities are: the protection, maintenance, and improvement of water quality; and the prevention, abatement, and control of sources of polluted runoff. In addition to these goals an anti-degradation policy is outlined in the UTNPS Plan. This policy states that "existing stream water uses shall be maintained and protected. No water quality degradation is allowable which would interfere with or become injurious to existing in stream water uses" (DEQ 2000). These goals directly relate to any new road construction project. Road construction projects are potential new sources of polluted runoff and can adversely affect waters of the state. Any new road construction project should comply with these goals and should not result in degradation of water quality. According to the UTNPS Plan road construction "will be considered where pollution will result only during the actual construction activity, and where BMPs will be employed to minimize pollution effects" (DEQ 2000). The UTNPS Plan emphasizes that

BMPs should be developed as a system. This system should be a combination of practices, along with a management philosophy committed to reducing non-point source pollution (DEQ 2000).

In addition, when implementing BMPs special consideration should be given to groundwater. Most BMPs are designed to increase infiltration of runoff into soils before reaching streams and other water bodies. Infiltration of polluted runoff could potentially contaminate local and regional aquifers. This is especially a concern with winter maintenance issues. The UTNPS Plan indicates that salt storage and road salting are major sources of groundwater contamination in the State of Utah (DEQ 2000). It should be determined whether BMPs will affect local or regional aquifers. If it is determined that winter maintenance practices could affect local aquifers, modifications to BMPs are recommended to the greatest extent practicable in order to prevent groundwater contamination.

Overall, development of a Storm Water Pollution Prevention Plan (SWP3) will be consistent with the UTNPS Plan and would satisfy the requirements outlined for the control of non-point source pollution. A Storm Water Management Plan does not exist for Provo Canyon at this time. In addition to the water quality analysis, the SEIS (FHWA 1989a) notes that a comprehensive sediment or erosion control program will be developed before construction to prevent impacts from sediment entering Provo River. In addition, the proposed action commits to developing a SWP3 that has all appropriate storm water runoff controls for short- and long-term highway runoff. The SWP3 often combines BMPs with other erosion-control methods.

Water Quality Impacts

Provo River water quality requires protection for several reasons. In addition to being the primary drinking water source for nearly every community along the populated Wasatch Front in Utah, the Provo River also supports a wide variety of fisheries, wildlife, agriculture, and recreational uses. Highway construction potentially affects water quality primarily through increased erosion and sedimentation. Other constituents of concern may include oil, fine tire particles, other petroleum products, and metals. These constituents are often carried into a water body with runoff from impervious surfaces, such as a highway, and are potentially toxic to aquatic organisms.

A Watershed Management Plan was completed for the Provo Canyon Scenic Byway (US-189) in 2000 (BIO-WEST et al. 2000). This plan is a non-binding document with the purpose of improving watershed conditions and controlling non-point source pollution in the watershed. Development of Total Maximum Daily Loads (TMDLs) for Total Phosphorus (TP) and TSS was one objective of the plan, since these pollutants are often associated with excess erosion and sedimentation and are acknowledged to be of primary concern in the watershed. Although the Provo River is not on the State of Utah 303(d) list as impaired for either TP or TSS, TMDLs for these constituents were created as a planning tool to protect and improve water quality by understanding and quantifying the relative contributions of these pollutants from various sources. An implementation plan does not exist for these TMDLs because they are simply components of this non-binding watershed management plan at this time.

Load reduction goals were established during the 2000 study for three sub-basins in the watershed: Provo River above Murdock Diversion, Deer Creek, and North Fork. Table 4-2 provides TP load summaries, while Table 4-3 presents load summaries for TSS.

Table 4-2. Total Maximum Daily Load (TMDL) Summary for Total Phosphorus (TP).

SUB-BASIN	YEAR 2000 LOAD (TONS/YEAR)	TARGET LOAD (TONS/YEAR)	LOAD REDUCTION GOALS (TONS/YEAR)
Provo River at Murdock Diversion	11.54	11.35	0.19
Deer Creek	0.42	0.38	0.04
North Fork	0.45	0.39	0.06

Table 4-3. Total Maximum Daily Load (TMDL) Summary for Total Suspended Solids (TSS).

SUB-BASIN	YEAR 2000 LOAD (TONS/YEAR)	TARGET LOAD (TONS/YEAR)	LOAD REDUCTION GOALS (TONS/YEAR)
Provo River at Murdock Diversion	2434.1	2434.1	0
Deer Creek	211.9	171.8	40.1
North Fork	182.0	144.1	37.9

The erosion analysis includes both the proposed four-lane highway and the existing highway. Because of its age, the existing highway design incorporates no known BMPs to reduce the amount of pollutants generated on the highway that enter Provo River. Therefore, any sediment from eroding cut slopes and fill areas along the existing road is often washed into drains and culverts that lead directly to Provo River. Under the proposed action, erosion, sediment, and other pollutants potentially impacting the river will be reduced by the implementation of long-term BMPs to manage stormwater runoff. Moreover, portions of the 2002 Preferred alignment will be farther from the river, decreasing impacts from direct runoff. Finally, the proposed action will include the development and implementation of a stormwater management plan to integrate short- and long-term erosion and sediment reduction practices that will protect the stream during and after construction.

Water quality within the watershed (particularly the Provo River) is primarily controlled by the operations of Jordanelle and Deer Creek Reservoirs, which have a much larger impact on the Provo River than the highway does or will have. The dams promote bed coarsening downstream because finer sediment is trapped behind them while released flows easily flush the gravel-sized particles downstream. Fish species in the river depend on the gravel-sized sediment for spawning habitat and are impacted if adequate material is not available. At the same time finer material, such as suspended clay particles, readily move downstream with flow releases, with attendant negative impacts upon spawning habitat. Highway-generated sediment, if not controlled adequately, can add to this particle size fraction and compound this impact.

The dams can also tend to cause impacts in terms of nutrient issues. Phosphorus is commonly attached to suspended clay particles and carried downstream with water releases, as is dissolved phosphorus. These phosphorus forms are readily available to plants and organisms, and excess phosphorus in the Provo River system promotes aquatic macrophyte and algal growth that impacts dissolved oxygen and lead to eutrophication. High levels of macrophyte growth will also hinder drinking water treatments. Again, highway runoff can also contribute nutrients through this process, but primarily during runoff events.

Cold water releases from Deer Creek Reservoir may also reduce dissolved oxygen levels below the dam. Late summer bottom releases are typically extremely low in dissolved oxygen. In addition, an analysis conducted in 1999 showed that flow regulation by Deer Creek Dam directly altered water temperature, pH, and dissolved oxygen.

Sediment Loads

The primary water quality impact of current concern is that construction-generated sediment would raise TSS to levels exceeding state of Utah water quality standards and violate the goals of the Watershed Management Plan. In order to quantify potential impacts and develop appropriate mitigation, a segment-specific TMDL for TSS was calculated as a part of this analysis, based on measured loads in the Provo River and upon the watershed TMDL developed as a component of the *Provo Canyon Scenic Byway Corridor and Watershed Management Plan* (BIO-WEST et al. 2000). No TMDL implementation plan exists for the Provo River, since the TMDLs were only developed as a part of the watershed planning process and not binding on any party. However, as a member of the steering committee for development of the plan, the Utah Department of Transportation (UDOT) has committed to its goals and objectives, and the design and construction of this segment will incorporate that commitment. The approach to development of this segment-specific TMDL and the results are presented below.

Some sediment is normal and expected in any natural stream system, but excess sediment can cause a variety of problems related to water quality. First, excess sediment can destroy fish habitat, since the fine particles cover and clog the spaces in spawning materials, rendering them inadequate for fish reproduction and population maintenance. Excessive sediment deposition also impacts aquatic food sources and, thus, fish growth and health. Sediment, particularly in this watershed, also carries phosphorous; thus an increase in sediment generally results in an increase in phosphorous. In this watershed specifically and Utah in general, increases in phosphorous often lead to eutrophication and, thus, reduced dissolved oxygen levels that restrict aquatic organism and fish growth and health.

In terms of drinking water, exceedance of state TSS standards in the Provo River would impair its beneficial use for drinking water. Additional treatment at considerable cost would be required in order to meet the drinking water standard for continued use. As noted previously, any impact to drinking water is a major concern because the Provo River supplies most of the Wasatch Front with drinking water.

In order to determine the level of impact road construction would have in terms of increased sediment load, the Universal Soil Loss Equation (USLE) was used to estimate soil erosion along the proposed construction corridor. The USLE describes soil loss given several factors:

$$\text{Erosion} = R * K * S * L * C * P,$$

where R describes the rainfall erosivity and K describes how easily a soil is eroded. Lumped together, S and L account for slope and length of the slope. The C relates to vegetation or cover, and the practice factor, P, refers to BMPs that reduce the amount of sediment generated or yielded to a stream.

Three scenarios were examined for this Project segment: existing erosion levels, erosion levels during construction, and erosion levels for the long-term post-construction period. For all three scenarios, the rainfall erosivity factor) was estimated to be 9 metric tons per hectare (10 tons per acre) per year (Haan et al. 1994). All scenarios were run assuming no use of BMPs in order to assess the maximum levels of sediment possible and compare the results with existing conditions. An additional analysis used the existing erosion levels to determine required P values to maintain current sediment levels during construction and in the post-construction stage.

The corridor was separated into 13 different sections, based on visual inspection of current cuts and eroded areas. The USLE was used to determine an erosion rate for each section and summed for a corridor total erosion rate. Although exact locations and details are subject to change during final design, the existing highway is currently planned for removal from the point of departure of the new alignment at approximately Station 19+950 (see Sheet 4 of the 2002 Preferred Alignment, Appendix E) to the existing Hoover Housing turnoff at approximately Station 20+900. The remainder of the existing highway not on the 2002 Preferred Alignment will be reconstructed as a low-use access for the housing area and/or as a recreational trail. Abandoned portions of the existing highway near the dam will be removed, with the portion on the dam crest returned to the U.S. Department of the Interior, Bureau of Reclamation (BOR) and the portion over Deer Creek removed and restored as stream channel. All portions of abandoned highway will be redesigned with appropriate erosion control and BMPs implemented. The sediment load analysis incorporated these actions as assumptions.

As discussed in detail under Indirect and Cumulative Impacts below, no additional residential or other development is anticipated in the Project corridor as the result of highway abandonment or overall construction.

Assuming a worst-case situation, a sediment yield of 100 percent was utilized for the analysis. Current conditions indicate that much of the available sediment is washed directly into culverts and drainage ditches that channel the runoff into the stream, particularly since the Provo River runs immediately adjacent to or near the road along much of the corridor. Although a 70 percent delivery ratio is often used in such situations, use of the 100 percent ratio provides a more appropriate and conservative estimate in this situation.

The BMP efficiencies were obtained from a general literature review and do not account for regional differences, particularly those related to high-elevation environments. However, the analysis assumed only an average efficiency for active construction and a minimum efficiency for post-construction BMPs. This use of lower-than-maximum efficiencies insures that the analysis has not inflated the effectiveness of BMPs. In accordance with standard UDOT specifications, topsoil will be harvested prior to excavation, and all BMPs that involve vegetation will be implemented using only native species. Native species will be used for all reclamation, rehabilitation, and slope stabilization work as well.

Table 4-4 presents estimated soil erosion using the USLE under existing (year 2000) conditions on the watershed. Table 4-5 estimates potential soil erosion from the watershed during construction without the use of appropriate BMPs. Table 4-5 also provides the change from the existing (year 2000) condition. Table 4-6 provides estimates of potential long-term post-construction erosion, as well as the change from existing (year 2000) conditions without BMPs.

Table 4-4. Potential Erosion under Existing Conditions without Best Management Practices (BMPs).

SECTION	K[a]	SL[b] WEST	SL[b] EAST	C[c]	TONS/ ACRE/YEAR	TONS/YEAR
1	0.38	12.50	3.80	0.98	61.73	89
2	0.38	3.27	3.18	0.77	19.50	9
3	0.38	19.31	1.39	0.53	42.50	47
4	0.37	8.04	1.77	0.83	29.99	138
5	0.38	3.13	0.63	0.20	2.90	4
6	0.38	9.92	5.14	0.65	37.41	100
7	0.41	9.16	2.90	0.20	9.84	27
8	0.37	8.96	3.65	0.40	18.93	303
9	0.39	2.72	0.85	0.2	2.81	50
10	0.31	15.05	4.43	0.29	17.40	91
11	0.30	2.54	7.29	0.44	13.18	458
12	0.38	2.80	20.00	0.45	39.65	470
13	0.13	5.90	3.85	0.26	3.24	67
TOTAL					299.08	1,855

[a] K= soil erosivity factor.
[b] SL= slope length factor consisting of S factor x L factor (dimensionless).
[c] C= cover factor (dimensionless).

The analysis without BMPs indicates an increase in potential erosion generated from the area during construction and in the post-construction stage. The potential erosion during construction increased approximately 4.5 times the existing conditions, while long-term post-construction estimates indicate an increase of 2.7 times the existing conditions. Since both R-rainfall erodibility and P-practices values were held constant throughout the analyses, the erosion increases result from increases in the slope (S), length (L), erodibility (K), and cover (C) factors.

Table 4-5. Potential Erosion During Construction without Best Management Practices (BMPs).

SECTION	K[a]	SL[b]	C[c]	TONS/ACRE/YEAR	TONS/YEAR	CHANGE FROM EXISTING CONDITION
1	0.10	126.44	1.30	164.38	333	244
2	0.10	127.41	1.30	165.64	101	92
3	0.10	118.53	1.30	154.09	203	157
4	0.10	16.85	1.30	21.91	136	-2
5	0.10	38.06	1.30	49.47	106	102
6	0.10	38.59	1.30	50.17	173	73
7	0.10	37.48	1.30	48.71	170	143
8	0.10	33.59	1.30	43.67	588	285
9	0.10	33.03	1.30	42.94	791	741
10	0.10	57.13	1.30	74.26	463	372
11	0.10	41.95	1.30	54.53	2,161	1,703
12	0.10	121.09	1.30	157.42	1,940	1,470
13	0.10	44.05	1.30	57.27	1,484	1,418
TOTAL				1,084.48	8,651	6,798

[a] K= soil erosivity factor.
[b] SL= slope length factor consisting of S factor x L factor (dimensionless).
[c] C= cover factor (dimensionless).

Table 4-6. Potential Erosion under Long-term Post-construction Conditions without Best Management Practices (BMPs).

SECTION	K[a]	SL[b]	C[c]	TONS/ACRE/YEAR	TONS/YEAR	CHANGE FROM EXISTING CONDITION
1	0.13	126.45	1.20	199.39	158.04	69
2	0.13	127.41	1.20	200.91	40.12	31
3	0.13	118.53	1.20	181.61	126.33	80
4	0.33	16.85	0.43	23.89	58.26	-80
5	0.20	38.05	0.20	15.42	13.74	10
6	0.19	38.59	0.97	72.15	109.49	10
7	0.39	37.48	0.31	45.91	114.36	87
8	0.37	33.59	0.24	29.60	302.22	-1
9	0.39	33.03	0.26	33.19	424.92	374
10	0.11	57.12	1.30	77.09	326.40	235
11	0.28	41.95	0.35	41.67	1359.81	902
12	0.13	121.09	1.20	184.68	1372.57	902
13	0.11	44.05	0.97	46.43	659.34	593
TOTAL				1,151.92	5,065.63	3,212

[a] K= soil erosivity factor.
[b] SL= slope length factor consisting of S factor x L factor (dimensionless).
[c] C= cover factor (dimensionless).

The changes in the S and L factors had the largest impact on erosion estimates for the construction and post-construction phases. The highway construction plans dictated the S and L factors in the two phases. The Project would steepen many slopes and thus result in increased levels of erosion. However, in a few sections slopes were flattened out, and overall erosion potential decreased (Section 4 in the construction and post-construction scenarios, as well as Section 8 in the post-construction scenario). However, during construction all sections would most likely experience erosion levels higher than existing conditions as a result of increased soil exposure and construction disturbances.

Overall, K factors decreased from the existing condition, but the potential decrease in erosion was easily offset by increases in the other factors. Assuming complete denudation of all sections, K factors were 0.1 (bare rock) for all sections in the construction scenario. The K factors decreased in the post- construction scenario for all sections as well. This decrease may have resulted from an increase in the amount of rock-exposed area compared with existing conditions. The post-construction K value assumes complete coverage with topsoil on all slopes from 0 percent to 50 percent (with 50 percent being 1 vertical to 2 horizontal) and rock above 50 percent. Thus, in many sections, if slopes increased above 50 percent, the K value given was 0.1.

The C factors also increased in each scenario. A worst-case scenario C of 1.3 was used for the construction phase. Since all areas were assumed denuded, each section was given a C value of 1.3. The increases seen in the post-construction scenario can be attributed to assumptions concerning revegetation. All slopes under 33 percent (1 vertical to 3 horizontal) were considered completely revegetated, while slopes between 33 percent and 50 percent were considered 50 percent revegetated. All slopes steeper than 50 percent were assumed to support no vegetation. Therefore, if the section had large areas with no or 50 percent vegetation, the C factor increased accordingly. Each section showed an increase in the C value from the existing condition estimates.

Erosion and Sediment Control

Erosion estimates show an increase above existing conditions in both the construction and post-construction scenarios. Therefore, steps will be taken to maintain water quality and prevent excess sediment in the Provo River. Best management practices provide techniques to control erosion and sediment. Short-term BMPs will be implemented to deal with construction erosion and sediment generation, and long-term BMPs will be implemented to control the expected increase in erosion after construction and restoration/revegetation have been completed. Final plans will ensure implementation of both construction and post-construction BMPs (i.e., erosion and sediment control) to minimize sediment yield. Tables 4-7 and 4-8 show estimated efficiencies of proposed BMPs. The BMPs that will be used for erosion and sediment control could also prevent some hazardous materials from entering the river in the event of an accidental release of such materials. Table 4-7 shows active construction BMP efficiency, while Table 4-8 shows long-term BMP efficiency. There are no known BMPs in this section of Provo Canyon at this time.

Table 4-7. Active Construction Best Management Practice (BMP) Efficiencies.

BEST MANAGEMENT PRACTICE	AVERAGE (%)	MAXIMUM (%)	MINIMUM (%)
1. Slope Stabilization (e.g., Mulch, Erosion Blankets, Geotextiles)	Used a modified C value to re-estimate erosion.	-	-
2. Gravel Check Dam[a]	56	75	36
3. Silt Fences	56	75	36
4. Excavated Sediment Trap[b]	47.5	65	30
5. Inlet Protection[a]	56	75	36

[a] Efficiency assumed similar to silt fence.
[b] Efficiency assumed similar to dry detention basin.

Table 4-8. Post-construction Best Management Practice (BMP) Efficiencies.

BEST MANAGEMENT PRACTICE	AVERAGE (%)	MAXIMUM (%)	MINIMUM (%)
1. Vegetated Swales	70	93	30
2. Dry Detention Basins	47.5	65	30
3. Filter Strips	70	100	20
4. Infiltration Trenches	74	90	50

Active Construction Best Management Practices (BMPs)

Active construction BMPs will include a comprehensive SWP3 that includes various forms of runoff management and surface protection (e.g., silt fence, straw bale barriers, protected ditches, sediment traps, erosion blankets), along with adequate inspection and maintenance of BMPs.

A new cover C factor was calculated and then used to estimate erosion reduction from slope stabilization. The C values for each slope class are as follows:

C= 1.3 for slopes greater than 50%
C= 0.2 for slopes between 33-50%
C= 0.11 for slopes 0-33%
Proposed road areas (exposed areas, no BMP) have a C value of 1.3 (Haan et al. 1994).

For each road section, a C mulch value was found by weighting each slope class C value by the area of each slope class, weighting the C road by the area of the road, and then averaging over the entire section area:

$$\frac{C(0\text{-}33\%)*area(0\text{-}33\%) + C(33\text{-}50\%)*area(33\text{-}50\%) + (C>50\%)*(area>50\%) + (Croad)*(road\ area)}{total\ section\ area}$$

Table 4-9 shows the estimated sediment reduction from BMP implementation. The column labeled "Projected Load with Best Management Practices" represents the amount of sediment estimated to result from implementing BMPs. In other words, the numbers represent the anticipated total load after BMPs are implemented. Therefore, the "Change From Current Conditions" column reflects the change in estimated sediment production from the current or existing condition to that of active construction and indicates a net improvement in water quality loading as the result of implementing the BMPs proposed for the segment. As discussed above, average efficiencies, except for slope stabilization, were used to calculate reductions for all BMPs by section.

Table 4-9. Active Construction Best Management Practice (BMP) Load Reduction.

ROAD SECTION	EXISTING LOAD (TONS/YEAR)	PROJECTED LOAD (TONS/YEAR)	LOAD INCREASE (TONS/YEAR)	PROJECTED LOAD WITH BEST MANAGEMENT PRACTICES (TONS/YEAR)	CHANGE FROM CURRENT CONDITIONS (TONS/YEAR)	BEST MANAGEMENT PRACTICES USED (FROM TABLE 4-7)
1	89	333	244	14	-74	1, 2, 3, 4, 5
2	9	101	92	19	10	1, 2, 3
3	47	203	157	38	-8.9	1, 2, 3
4	138	136	-2	4.4	-134	1, 2, 3, 4, 5
5	4	106	102	4.2	0.3	1, 2, 3, 4, 5
6	100	173	73	6.8	-93	1, 2, 3, 4, 5
7	27	170	143	3.2	-24	1, 2, 3, 4, 5
8	303	588	285	39	-264	1, 2, 3
9	50	791	741	15	-36	1, 2, 3, 4, 5
10	91	463	372	20	-71	1, 2, 3, 4, 5
11	458	2,161	1,703	35	-423	1, 2, 3, 4, 5
12	470	1,940	1,470	82	-388	1, 2, 3, 4, 5
13	67	1,484	1,418	57	-10	1, 2, 3, 4, 5
TOTAL	1,855	8,651	6,798	338	-1,516	-

Notice that sediment loads are reduced during active construction by 1,516 tons per year with BMP implementation, compared to the 6,798 tons per year increase (4.7 times existing loads) without BMPs. Net load reductions occur during active construction with BMPs because BMPs would be implemented on the entire area, including the existing road and drainage system. As noted above, BMPs are not in place along the existing roadway system, thus the sediment estimate for existing conditions is high.

Additional BMPs would further reduce the sediment load generated during active construction. Water bars and slope drains on the exposed road surface may reduce the sediment transported by runoff from the road cut. Other active-construction BMPs should include diversion ditches to reduce the amount of flow reaching exposed areas that are highly susceptible to erosion and larger sediment sources. Finally, berms can also be used to help contain sediment. For BMPs to function properly, they must be implemented correctly and maintained. Each BMP has its own unique requirements for construction/implementation and maintenance.

Slope Stabilization

Slope stabilization techniques vary and may include mulch and geotextiles. Mulching is the primary method used in this analysis. It is defined as the placement of material (straw, grass, fibers, fabricated matting) over an open area (Olsen 1998). If used properly, mulching serves to reduce flow velocity and thus erosivity of the flow. Mulching also anchors the soil and facilitates plant growth. Mulching limits are based mostly on slope. Mulch may not remain on steep slopes without anchoring. High runoff may actually transport loose mulch material downslope. Installation requires that the slope has enough surface roughness depressions that will hold mulch. In addition, the material must be weed-free and not inhibit plant growth. Inspection and replacement of mulch are the primary maintenance tools. Downgradient controls must also be cleared of any mulch that has washed off the slope.

Gravel Check Dams

Rock or gravel check dams are small, temporary dams that cross dry drainages. They are used to reduce erosion by reducing flow velocity and trapping sediment and debris (Olsen 1998). They have a maximum drainage area of 4 hectares (10 acres) and should not exceed 61 centimeters (24 inches) in height. Most importantly, rock check dams are used in drainage paths, not running streams. These dams are easily constructed by simply placing rocks in the drainage path, with side slopes about 50 percent and a low point in the center to allow flow over the dam. Maintenance includes inspection at least monthly and after a rain event. In addition, built-up sediment must be removed, as well as any debris caught behind the dam.

Silt Fences

A silt fence is a temporary barrier consisting of filter fabric stretched across and secured to support posts. Straw bales act in a similar manner. Silt fences must be entrenched as well (Olsen 1998). Silt fences reduce sediment by filtering storm water generated upgradient and trapping sediment on site. There are several limitations in the use of silt fences to control sediment. Maximum drainage area is 0.2 hectare (0.5 acre) per 9 meters (100 feet) of fence. Maximum upgradient slope is 46 meters (150 feet) and maximum uphill slope is 50 percent. Maintenance involves inspection, particularly after rainfall and daily during extended rainfall. During inspection, check for runoff that is bypassing fence ends or cutting under the fence. Repair and replace fences that have been damaged and re-anchor when water cuts around the fence. Excavate sediment traps when sediment rises to one-half the height of the fence.

Excavated Sediment Traps

These BMPs are small containment areas with a gravel outlet. They reduce velocities and peak discharges from storm water runoff. These structures create conditions that allow runoff to pool and some sediment to settle. This protects areas downstream from higher sediment loads from runoff (Olsen 1998). Each trap must be designed to accommodate anticipated runoff and sediment loads from the drainage area. A silt fence can be used to reduce fine silts and clays at the outlet. Inspection and repair are part of maintenance, as well as sediment removal once the trap is two-thirds full. In addition, the outlet area must be protected from erosion.

Inlet Protection

Inlet protection refers to the reduction of sediment entering a storm drain by filtering storm water and reducing the velocity of the storm water, thus allowing some deposition. Inlet protection can be done with a concrete block, filter cloth, and gravel filter placed over the storm drain inlet. However, such a measure is recommended for a maximum drainage of 0.4 hectare (1.0 acre). Excess flows may bypass the inlet, and ponding can occur at the inlet. Inspection, sediment removal, and filter replacement are necessary maintenance procedure for this BMP.

Water Bars

Water bars help control erosion from unpaved roads or trails. They are constructed to drain water off the unpaved surface to a controlled discharge point. Water bars can help prevent rills from forming on slopes, which can become significant sediment sources. Some limitations in using water bars include the need for a stable discharge point that is not sensitive to large increases in runoff and the discharge must be filtered prior to entering a water body. Finally, water bars must be designed to meet project specifications and placed in appropriate areas. Such areas are based on slopes and runoff patterns. Maintenance includes inspection for erosion at the discharge point and repair of the structures, particularly after rainfall and during extended rainfall. Like the other BMPs, sediment removal should be done when necessary (Olsen 1998).

Slope Drains

Slope drains carry water from the top of a slope to the bottom of the slope. They convey runoff around disturbed areas, thus reducing possible erosion from water flow, and drain saturated slopes that have potential for soil slides. Slope drains are used on cut and fill slopes prior to installation of permanent drainage structures, where other diversion measures have concentrated flow, and where concentrated runoff can cause soil erosion and rilling. Slope drains are unsuitable for areas greater that 4 hectares (9.8 acres) (Olsen 1998). Slope drains should be placed on undisturbed or well-compacted soils with a filter cloth on all sides. Stake the drain at intervals of no more than 3.0 meters (9.8 feet) and place the discharge point at a non-erosive site, possible enforced with rip-rap (Olsen 1998).

Post-construction Best Management Practices (BMPs)

Long-term BMPs will include prompt and successful revegetation of all slopes under 50 percent, rock-lined grass swales to slow water and filter sediment, permanent sediment traps, etc. Proper removal and disposal of detained sediment will also be included in long-term BMPs. Table 4-10 shows estimated reductions of increased sediment. The column labeled “Projected Load . . .”

Table 4-10. Post-construction Best Management Practice (BMP) Load Reduction.

ROAD SECTION	EXISTING LOAD (TONS/YEAR)	PROJECTED LOAD (TONS/YEAR)	LOAD INCREASE (TONS/YEAR)	PROJECTED LOAD WITH BEST MANAGEMENT PRACTICES (TONS/YEAR)	CHANGE FROM CURRENT CONDITIONS (TONS/YEAR)	BEST MANAGEMENT PRACTICES USED (FROM TABLE 4-8)
1	89	158	69	62	-27	1, 2, 3
2	9	40	31	22	13	1, 3
3	47	126	80	71	24	1, 3
4	138	58	-80	23	-116	1, 2, 3
5	4	14	10	3	-1.2	1, 2, 3, 4
6	100	109	10	43	-57	1, 2, 3
7	27	115	87	22	-4.8	1, 2, 3, 4
8	303	302	-1	63	-239	1, 3, 4
9	50	425	374	63	12	1, 2, 3, 4
10	91	326	235	48	-43	1, 2, 3, 4
11	458	1360	902	200	-258	1, 2, 3, 4
12	470	1373	902	538	68	1, 2, 3
13	67	659	593	129	63	1, 2, 3, 4
TOTAL	1,855	5,065	3,212	1,287	-566	-

represents the amount of sediment estimated to result from implementing BMPs. In other words, the numbers represent the anticipated total load after BMPs are implemented. Therefore, the "Change From Current Conditions" column reflects the change in estimated sediment production from the current or existing condition to that of active construction and indicates a net improvement in water quality loading as the result of implementing the BMPs proposed for the Project. As discussed above, minimum efficiencies for BMPs were used to calculate reductions to give a conservative estimate of how well the BMPs may work.

Other long-term BMPs should help reduce the sediment load in Provo River. Retaining walls, outlet protection, and channel stabilization each have some sediment retention capacity. Retaining walls eliminate any sediment in the area where they will be placed. Again, proper implementation and maintenance of these BMPs are vital to ensure adequate function and sediment removal. The proposed BMPs are briefly outlined below.

Vegetated Swales

The SEIS (FHWA 1989a) notes that vegetated swales can be used to reduce the amount of pollution entering the Provo River from the road. They are channel-like structures that are lined with grass and gravel. Swales collect runoff from the road and reduce velocity. This allows for sediment, and often other pollutants attached to sediment particles, to settle out prior to reaching a water body.

During initial construction, grass must be established. Once this occurs, the swale needs to be checked periodically for damage and bank stability (Salix 1998), particularly near road crossings and outlets. Other Maintenance procedures include repairs to channel from damage done by debris or scour, and mowing or irrigating to control the grass. Finally, if a significant amount of sediment builds up, removal is necessary (Salix 1998).

Detention Basins
These act similarly to the excavated sediment trap, a short-term BMP. Maintenance includes regular inspection and repair to damaged basins. In addition, the outlet must be protected from erosion.

Infiltration Trenches
These trenches are deep pits filled with coarse-grained material, usually gravel. They are designed to collect water from a ditch or swale and cause ponding. Water from the ditch enters into the trench, which captures and filters the water. Over time, the trench may fill with sediment. Maintenance activities include periodic inspection, repairs to any damaged parts of the trench, and possible sediment removal if the trench becomes clogged.

Filter Strips
Filter strips are similar to vegetated channels. They accept runoff from adjacent surfaces. They slow runoff and filter out sediment and other pollutants. They are limited by the volume of runoff they can handle. Draining too much area through the filter is a primary abuse of this BMP. Inspection, repair, and excess sediment removal are basic Maintenance actions.

Impact Summary
Because of its proximity to the Provo River, the 1989 SEIS Alignment would have increased direct and indirect impacts to water resources in the Project Area compared with the 2002 Preferred Alignment. These impacts would include increased pollution concentrations from sedimentation, stormwater runoff, soil erosion, and other point sources. Since the plans and subsequent construction will impellent these BMPs, it is anticipated that the 2002 Preferred Alignment would result in an overall improved condition for water resources.

Floodplains

No Project-related floodplain impacts would occur from implementation of either the 1989 SEIS or 2002 Preferred Alignments. No fill would be placed in floodplains, and no further coordination with the Federal Emergency Management Agency is required. Both alternatives are in compliance with Executive Order 11988, Floodplain Management.

Hazardous Waste Sites

Since no known, potential, regulated, or non-regulated hazardous waste sites have been identified within the Project Area by the Utah Department of Health, no hazardous waste sites will be affected by either of the alternatives.

Vegetation and Wildlife

Direct impacts to wildlife consist of any modification or alteration caused by Project implementation, including construction and maintenance, that affects wildlife or their habitat. Indirect impacts would include those associated with increased disturbance to adjacent habitats because of construction activities, road use, and degradation of water quality resulting from road runoff and/or sedimentation. Impacts to wildlife from placement of the new highway would fall into three general categories: (1) direct loss of individuals, (2) loss of habitat, and (3) disturbance to wildlife species during critical life history periods. An evaluation of the effects of the 1989 SEIS and 2002 Preferred Alignments on wildlife is based on these categories.

Unique or rare wildlife habitats within the Wildwood to Deer Creek State Park Segment consist of wetlands, riparian forests, and oak/maple woodlands. However, loss in all habitat types represents impacts to each wildlife group potentially using each habitat described in the Wildlife and Vegetation section of Chapter 3. Habitat loss was quantified by overlaying maps of the 2002 Preferred and 1989 SEIS Alignments with habitat locations then calculating losses in hectares (acres). Total habitat losses resulting from the 1989 SEIS and 2002 Preferred Alignments are summarized in Table 4-11. Habitat losses of unique or rare habitats are summarized in Table 4-12. These impacts are discussed below by roadway sections as defined in Chapter 2 (Figure 2-1). Although the Preferred Alignment has greater potential impacts to overall habitat, the 1989 SEIS Alignment has greater potential impact to unique and rare habitat.

Table 4-11. Summary of Potential Impacts to Each Wildlife Habitat Type.

WILDLIFE HABITATS	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
Riparian/Wetland Forests		
Riparian	3.18 hectares (7.86 acres)	2.58 hectares (6.37 acres)
Palustrine Forested Wetland (PF)	0.05 hectare (0.12 acre)	0.00 hectare (0.00 acre)
Palustrine Scrub/Shrub Wetland (PSS)	0.22 hectare (0.55 acre)	0.18 hectare (0.44 acre)
Palustrine Emergent Wetland (PEM)	0.01 hectare (0.03 acre)	0.52 hectare (1.29 acres)
Riverine - Upper Perennial Wetland (PER)	0.34 hectare (0.84 acre)	0.07 hectare (0.17 acre)
Oak/Maple Woodland	5.21 hectares (12.86 acres)	5.68 hectares (14.04 acres)
Sagebrush	5.69 hectares (14.06 acres)	12.69 hectares (31.36 acres)
Grassland	2.73 hectares (6.74 acres)	7.59 hectares (18.75 acres)
Coniferous Forests	0.44 hectare (1.09 acres)	0.30 hectare (0.74 acre)
Total	17.87 hectares (44.15 acres)	29.61 hectares (73.16 acres)

Table 4-12. Potential Impacts to Unique and Rare Habitats.

WILDLIFE HABITATS	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
Section 1	9.09 hectares (22.46 acres)	3.05 hectares (7.54 acres)
Section 2	1.33 hectares (3.29 acres)	0.93 hectare (2.30 acres)
Section 3	5.32 hectares (13.15 acres)	4.74 hectares (11.71 acres)
Section 4	0.37 hectare (0.91 acre)	0.37 hectare (0.91 acre)
Total	16.11 hectares (39.81 acres)	9.09 hectares (22.46 acres)

General Vegetation and Wildlife Habitat

Section 1

The 2002 Preferred Alignment in Section 1 would eliminate a total of 3.05 hectares (7.54 acres) of wildlife habitat, both upland and wetland, that are considered unique or rare within the Wildwood to Deer Creek State Park Segment. Wildlife using these habitats would be displaced. Loss of less mobile individuals, such as amphibians and reptiles, would likely occur. In addition, species using habitats adjacent to the road alignment in Section 1 would be indirectly affected by the increase in disturbance caused by construction activities and traffic. Important habitat types that would be permanently lost under the 2002 Preferred Alignment include 0.05 hectare (0.12 acre) of riparian upland forests, 2.99 hectares (7.39 acres) of oak/maple woodlands, and 0.01 hectare (0.02 acre) of palustrine scrub/shrub wetlands.

The loss in acreage of unique or rare habitats (Table 4-12) would be less under the 2002 Preferred Alignment than under the 1989 SEIS Alignment (9.09 hectares [22.46 acres] would be lost under the SEIS option). The primary advantage of the 2002 Preferred Alignment when compared with the 1989 SEIS Alignment would be the movement of the road away from the riparian corridor, thereby avoiding impacts to river otter (*Lutra canadensis*), bald eagle (*Haliaeetus leucocephalus*), and other species dependent on the habitat. Impacts to wetland habitats would also be minimized by the 2002 Preferred Alignment.

Section 2

The 2002 Preferred Alignment in Section 2 would eliminate a total of 0.93 hectare (2.30 acres) of wildlife habitat, both upland and wetland, that is considered unique or rare within the Wildwood to Deer Creek State Park Segment. Direct and indirect effects to wildlife resulting from loss of habitat and increased disturbance are similar to those described for Section 1. Important habitat types that would be permanently lost by road placement include 0.33 hectare (0.82 acre) of riparian upland forests, 0.10 hectare (0.25 acre) of oak/maple woodlands, 0.05 hectare (0.12 acre) of palustrine scrub/shrub wetlands, and 0.45 hectare (1.11 acres) of palustrine emergent wetlands.

The loss in acreage of unique or rare habitats would be much less under the 2002 Preferred Alignment than under the 1989 SEIS Alignment (1.33 hectares [3.29 acres] would be lost under the 1989 SEIS Alignment). Compared with the 1989 SEIS Alignment, the 2002 Preferred Alignment would direct the road away from the river and riparian habitat, thereby avoiding impacts to river otter, bald eagle, and other species dependent on the habitat. However, in doing so, a greater amount of wetlands and associated wildlife would be affected. In addition, adverse impacts to big game would occur.

Section 3

The 2002 Preferred Alignment in Section 3 would eliminate a total of 4.74 hectares (11.71 acres) of habitat, both upland and wetland, that are considered unique or rare within the Wildwood to Deer Creek State Park Segment. Important habitat types that would be permanently lost include 2.26 hectares (5.58 acres) of riparian upland forests, 2.22 hectares (5.49 acres) of oak/maple woodlands, 0.12 hectare (0.30 acre) of palustrine scrub/shrub wetlands, 0.07 hectare (0.17 acre) of palustrine emergent wetlands, and 0.07 hectare (0.17 acre) of riverine habitat associated with Deer Creek. Direct and indirect effects to wildlife resulting from loss of habitat and increased disturbance are similar to those described for Section 1.

The loss in acreage of unique or rare habitats would be less under the 2002 Preferred Alignment than under the 1989 SEIS Alignment (5.32 hectares [13.15 acres] would be lost under the 1989 SEIS Alignment). Compared with the 1989 SEIS Alignment, the 2002 Preferred Alignment would eliminate more riparian forest, perennial stream, and wetland habitats, but less oak/maple woodland habitat.

Section 4

For both the 2002 Preferred and the 1989 SEIS Alignments, the only important or unique habitat type that would be permanently eliminated in Section 4 would be 0.37 hectare (0.91 acre) of oak/maple woodlands. Disturbance during construction and later use of the highway would have a minimal effect on most wildlife species, since the area contains a limited amount of important or unique habitats and is already highly disturbed.

Noxious Weeds

Because highway construction would involve ground disturbance, both the 1989 SEIS and 2002 Preferred Alignments would potentially result in the spread of noxious weeds within the Project Area. The 1989 SEIS Alignment would disturb approximately 17.87 hectares (44.15 acres), and the 2002 Preferred Alignment would disturb approximately 29.61 hectares (73.16 acres) (Table 4-1). As discussed in Chapter 2, a haul road was constructed along the Preferred Alignment corridor in 1996, which generated most of this disturbance. Minor additional disturbance would occur during construction. Populations of noxious weeds are thought to currently exist in the Project Area within the general area of the 1989 SEIS and 2002 Preferred Alignments. In accordance with standard UDOT practices, an Invasive Weed Control special provision with noxious weed control and removal details will be included in the construction package for the Project. In addition, UDOT has in place a highly regarded and effective noxious weed management and monitoring program supervised by their Maintenance Division that will be incorporated into the normal maintenance of the completed Project. Funds for noxious weed control will be available for this effort. Appropriate management actions and monitoring activities would be implemented to minimize noxious weed spread potential; these actions and activities are specified in the Mitigation Measures section of this chapter.

Big Game

Section 1

The 2002 Preferred Alignment in Section 1 would travel through high priority deer winter range and would eliminate approximately 0.13 hectare (0.32 acre) of forage and 3.32 hectares (8.20 acres) of cover. However, the road would occur in a relatively disturbed area that is not heavily used by big game. The route would also be screened from areas of big game use by topographic features. Therefore, impacts to big game would be minimal in Section 1.

Effects to big game by the 2002 Preferred and 1989 SEIS Alignments would be similar in Section 1, except less forage and more cover would be lost by the 2002 Preferred Alignment. The 1989 SEIS Alignment would eliminate approximately 1.48 hectares (3.66 acres) of forage and 1.70 hectares (4.20 acres) of cover.

Section 2

The 2002 Preferred Alignment in Section 2 would bisect critical winter range and remove approximately 11.27 hectares (27.85 acres) of forage and 0.43 hectare (1.07 acres) of cover. This area is particularly important to herds during periods of high population densities and during severe winters when big game move downslope to avoid deep snow. The detrimental effects of the alignment in Section 2 to big game herds would consist of permanent displacement of the mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) that utilize the area extensively during the winter. Accessible wintering areas are available in the surrounding habitat, such as near the upper portion of Deer Creek. Herds would be temporarily stressed during the period of adjustment while the animals realize the presence of a disturbance and adjust to a new wintering area. Road placement would also potentially result in increased mortality as a result of vehicle/big game collisions; however, placement of deer-proof fencing on both sides of the new highway clear zone (see the Mitigation Measures section of this chapter) would minimize mortality.

The 2002 Preferred Alignment would have a greater effect on big game populations than the 1989 SEIS Alignment. The most detrimental impact would be the placement of the road in an area that would cause displacement of wintering herds as opposed to placement in an area that receives little use. In addition, the 1989 SEIS Alignment would eliminate substantially less forage (approximately 2.57 hectares [6.35 acres]) but slightly more cover (1.35 hectares [3.34 acres]).

Section 3

High-priority and critical deer winter range would be directly impacted by road placement in Section 3. Detrimental effects of the alignment would consist of increased stress (resulting from disturbance related to construction and traffic) and possible displacement of deer and elk that utilize the area. In addition, approximately 7.97 hectares (19.69 acres) of forage and 4.50 hectares (11.12 acres) of cover would be eliminated. Since this area is part of a migration corridor for big game, increased mortality resulting from vehicle/big game collisions may occur. However, mortality would be minimized by the proposed placement of deer-proof fencing on both sides of the new highway clear zone (see the Mitigation Measures section of this chapter).

Impacts to big game would be similar for both road alignment options with the exception that the 2002 Preferred Alignment would eliminate less forage (approximately 4.77 hectares [11.79 acres]) and more cover (5.46 hectares [13.49 acres]).

Section 4

The 2002 Preferred and 1989 SEIS Alignments would both travel the same route through critical deer winter range in Section 4. In addition, 1.08 hectares (2.67 acres) of forage and 0.37 hectare (0.91 acres) of cover would be eliminated. While the alignment would be located in a relatively disturbed area that is not currently used to a great extent by big game, the area is used as a travel corridor. Thus, an increase in mortality due to big game/vehicle collisions may occur. However, mortality would be minimized by placement of deer-proof fencing on both sides of the new highway clear zone and construction of a big game underpass between Deer Creek State Park and Main Creek at Wallsburg Bay (see the Mitigation Measures section of this chapter).

Birds

Sandhill Crane

There would be no impacts to sandhill crane (*Grus canadensis*) in roadway Sections 1 or 4, or in the majority of sections 2 and 3. A nesting pair of sandhill cranes has been reported in the Canyon Meadows area, which is located near the junction of roadway Sections 2 and 3. If this pair were displaced from Canyon Meadows by the highway realignment, they would more than likely be displaced to other areas of Wasatch County (e.g., Wallsburg, Midway, Charleston, middle Provo River meadow areas) (Sakaguchi 2000).

Wild Turkey

There would be no impacts to Rio Grand wild turkey *(Meleagris gallopavo intermedia*) in roadway Sections 1 or 4, or in the majority of Sections 2 and 3. In the Canyon Meadows area near the junction of roadway Sections 2 and 3, there is suitable habitat on both sides of Provo Canyon for Rio Grande wild turkey. The 2002 Preferred Alignment near the Canyon Meadows area would reduce some of the available open meadow that is Rio Grande wild turkey habitat. This would constitute a minimal impact to Rio Grande wild turkey (Sakaguchi 2000).

Raptors

Impacts to raptors – nesting golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), and great-horned owl (*Bubo virginianus*) – by either the 2002 Preferred or SEIS Alternative are identified by roadway Section below. Potential impacts to wintering bald eagles are addressed in the subsequent discussion of Threatened, Endangered, and Candidate Vegetation and Wildlife Species.

<u>Section 1</u>

Impacts to raptors by either the 2002 Preferred or SEIS Alternative would be minimal in Section 1 since most raptors do not use this section of the corridor for nesting or foraging because of current levels of disturbance. Temporal restrictions would be placed on construction to avoid disturbance to golden eagles nesting in the surrounding cliffs. In addition, as requested by the U.S. Fish and Wildlife Service (USFWS) and the Utah Division of Wildlife Resources (UDWR) (see Appendix F) golden eagle nest surveys would be conducted immediately prior to construction (see the Mitigation Measures section of this chapter).

Section 2

As discussed in Chapter 2, a haul road was constructed along the Preferred Alignment corridor in 1996, which generated most of this disturbance. Minor additional disturbance would occur during construction. The 2002 Preferred Alignment in Section 2 would bisect an area that is likely used by foraging raptors. The elimination of foraging habitat (primarily grassland and sagebrush communities) and disturbance created by construction activities and traffic would likely cause displacement of foraging raptors. However, these types of habitats are common in the surrounding area and raptor use would readily transfer. A small amount of nesting habitat would also be eliminated. Nesting of golden eagles in the surrounding cliffs would not be adversely affected as described under Section 1.

The 1989 SEIS Alignment would have less impact on raptors since it would be placed in an area currently receiving high levels of disturbance related to recreational use, and road traffic and maintenance. In addition, a smaller amount of nesting and foraging habitat would be affected by the 1989 SEIS Alignment. As identified in the Mitigation Measures section of this chapter, golden eagle nest surveys would be conducted prior to construction.

Section 3

Placement of Section 3 in the 2002 Preferred Alignment would eliminate a minor amount of foraging and nesting habitat for raptors and cause some disturbance and possible displacement to individuals using adjacent habitats. Foraging habitat, primarily grassland and sagebrush communities, is relatively common in the surrounding area. However, wooded areas containing large trees for nesting are more scarce in the Provo River corridor. Some raptors show a fidelity to nesting sites and return annually to the same nest or area. Those wooded areas that have been or would be directly or indirectly affected by the 2002 Preferred Alignment in Section 3 have been or would be protected during construction to the extent possible, and extensive revegetation of appropriate species has been or would be implemented. Temporal restrictions would be placed on construction to avoid disturbance to golden eagles nesting in the surrounding cliffs.

In general, a similar amount of foraging and nesting habitat would be affected under the 1989 SEIS and Preferred Alignments. As identified in the Mitigation Measures section of this chapter, golden eagle nest surveys would be conducted prior to construction.

Section 4

Impacts to raptors would be minimal in Section 4 for both the 2002 Preferred and 1989 SEIS Alignments for reasons described under Section 1. As identified in the Mitigation Measures section of this chapter, temporal restrictions would be placed on construction to avoid disturbance to golden eagles nesting in the surrounding cliffs. In addition, golden eagle nest surveys would be conducted prior to construction.

Columbia Spotted Frog

Although neither individuals nor suitable habitat was identified during 1994 surveys, Columbia spotted frog (the species previously referred to as Oregon spotted frog [*Rana pretiosa*] and now called Columbia spotted frog [*Rana luteiventris*]) could be present in Project Area springs and seeps that have a permanent water source (Yeager 1994). To meet the goals and objectives of the Conservation Agreement and Strategy for Columbia spotted frog (Perkins and Lentsch 1998), early springtime surveys of all wetlands between Wildwood and Deer Creek State Park that are suitable spotted frog habitat and would be impacted by construction activities would be conducted prior to commencing construction activities (see the Mitigation Measures section of this chapter).

Threatened, Endangered, and Candidate Species

Threatened and endangered species potentially occurring near the Project Area in Utah County include bald eagle, Canada lynx (*Lynx canadensis*), clay phacelia (*Phacelia argillacea*), Deseret milkvetch (*Astragalus desereticus*), Utah valvata snail (*Valvata utahensis*), and Ute ladies'-tresses orchid (*Spiranthes diluvialis*). In Wasatch County such species include bald eagle, Canada lynx, and the Ute ladies'-tresses orchid. Potential impacts to these species are identified by roadway section below. As noted in Chapter 3, there are no candidate species in the Project Area.

Section 1

The 2002 Preferred Alignment, because it would move the highway further away from bald eagle roosting habitat, is not expected to impact any additional bald eagle roosting habitat. In fact, it is expected that the 2002 Preferred Alignment would actually provide a net improvement to bald eagle habitat (USFWS 2001). However, the 1989 SEIS Alignment would impact 0.39 hectare (0.96 acre) of bald eagle habitat. Additionally, construction-related impacts would not be expected because they take place during the summer, rather than the winter when bald eagles use the canyon for roosting. Implementation of the 2002 Preferred Alignment is not likely to adversely affect the bald eagle (USFWS 2001).

Canada lynx are uncommon in the Project Area because of its distance from the core ranges of the species and their naturally low densities. If present, adverse effects would be minimal, as the species maintains large home ranges and has relatively general habitat requirements. Habitat that would be affected by road construction and subsequent use is located near the existing road corridor, residential areas, campgrounds, and general recreation areas, and subsequently is of low value. Thus, this species is not likely to be adversely affected by the Project.

Potential impacts to clay phacelia, Deseret milkvetch, and Utah valvata snail would be highly unlikely. These species are listed by the USFWS as potentially occurring in Utah County, and all remaining construction would occur in Wasatch County. Second, as noted in Chapter 3, all known populations of clay phacelia and Deseret milkvetch are located outside of Provo Canyon, and Utah valvata snail does not occur in areas that would be affected by the Project segment (Williams 1995). Furthermore, as described in the Mitigation Measures section of this chapter, BMPs to be incorporated as part of the construction activities would prevent silt-laden runoff from entering Provo River, the potential habitat for Utah valvata snail. The proposed Project segment would not affect Ute ladies'-tresses since the species does not occur in areas to be affected by the 2002 Preferred Alignment (Williams 1995).

Section 2

Bald eagle would not be affected by implementation of the 2002 Preferred Alignment in Section 2 (USFWS 2001). In comparison, the 1989 SEIS Alignment would eliminate approximately 1.08 hectares (2.67 acres) of habitat.

The 2002 Preferred Alignment would not impact Canada lynx, clay phacelia, Deseret milkvetch, Utah valvata snail, or Ute ladies'-tresses for those reasons identified in Section 1.

Section 3

Although there is documented bald eagle use of Section 3 during winter months, none of this habitat would be lost from construction of the 2002 Preferred Alignment. Habitat for bald eagle in this area would actually be expected to improve (Maddux 2001). Conversely, 1.89 hectares (4.67 acres) would be lost by implementing the 1989 SEIS Alignment.

The 2002 Preferred Alignment would not impact Canada lynx, clay phacelia, Deseret milkvetch, Utah valvata snail, or Ute ladies'-tresses for those reasons identified in Section 1.

Section 4

Within Section 4, habitat for listed species would not be impacted by the 2002 Preferred or 1989 SEIS Alignments.

Table 4-13 summarizes the effects of the 2002 Preferred Alignment and the 1989 SEIS Alignment on vegetation, wildlife habitat, and wildlife species. Detailed mitigation measures are presented later in this chapter. As indicated in the agency correspondence in Appendix F, extensive coordination with both the UDWR and the USFWS has taken place throughout the development of the Project. Wildlife crossings have been included in this coordination and will continue during actual design. The existing highway includes no facilities at all for wildlife crossing, thus the Project can be expected to be a general improvement in that regard. In addition, portions of the new highway will be relocated further away from the Provo River, and thus should further enhance the safe movement of game and non-game wildlife in that immediate area.

Wetlands

The early pioneers to the overall Project Area, including Provo Canyon, developed roads, dams, powerplants, and other facilities in the mid 1800s, prior to any involvement in the area by either the State of Utah or the Federal Department of Transportation. Since those agencies have become involved and Federal funding has been utilized on the Project, mitigation in excess of impacts has been approved under the Clean Water Act (CWA) and developed. Although CWA permitting for the current segment has been completed previously and mitigation is in place and accepted by the U.S. Department of the Army, Corps of Engineers (Corps), a new permit will be obtained to cover the remaining 0.47 hectares (1.16 acres) of impacts anticipated during construction of the Wildwood

Table 4-13. Summary of Effects on Vegetation and Wildlife.

WILDLIFE GROUP	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
General Wildlife	Elimination of a total of 16.11 hectares (39.81 acres) of important habitat. Disturbance to wildlife in adjacent habitats. Greatest impact on riparian habitats and associated wildlife.	Elimination of a total of 9.09 hectares (22.46 acres) of important habitat. Disturbance to wildlife in adjacent habitats.
Big Game	Placement of road in an area that receives little use. Loss of 9.90 hectares (24.47 acres) of forage and 8.88 hectares (21.94 acres) of cover. Potential for increased mortality. Effects to critical deer winter range and high priority winter range.	Total loss of 20.45 hectares (50.53 acres) of forage and 8.62 hectares (21.30 acres) of cover. Increased stress, mortality, and possible displacement in some portions of the corridor. Effects to critical deer winter range and high priority winter range.
Sandhill Crane	Not applicable (this species was not evaluated in the 1989 SEIS).	Displacement of potential nesting pair near the junction of roadway Sections 2 and 3 to other habitat in Wasatch County. Overall impacts are low.
Wild Turkey	Not applicable (this species was not evaluated in the 1989 SEIS).	Loss of available habitat near the junction of roadway Sections 2 and 3. Displacement of birds to suitable habitat on other side of highway in this area. Overall impacts are low.
Raptors	Loss of foraging and nesting habitat. Overall impacts are low.	Loss of foraging and nesting habitat. Overall impacts are low.
Columbia Spotted Frog	Not applicable (this species was not identified in the 1989 SEIS).	No effects on known populations of Columbia spotted frog.
Threatened, Endangered, and Candidate Species	Loss of a total of 3.36 hectares (8.30 acres) of bald eagle roosting habitat. Potential displacement of eagles in Sections 1 and 3 because of road proximity.	No loss of bald eagle roosting habitat. Probable gain in habitat because road would be re-located further from habitat.

to Deer Creek State Park Segment along the haul road and the restoration of the lower portion of Deer Creek.

Considerable discussion of resource protection strategies and mitigation from direct impacts is presented in the this chapter, and has been extensively coordinated with the various Federal, State, and local agencies and stakeholders. Additional discussion regarding potential and likely development both in the Project corridor and elsewhere in the cumulative impacts area is presented under Indirect and Cumulative Impacts.

Direct Impacts

Direct impacts are those that would result from actions that would physically alter wetlands and are site-specific, predictable, and quantifiable. Actions resulting in the placement of dredged and/or fill material into jurisdictional wetlands are considered direct adverse impacts, because the functions and values of affected wetlands would be permanently lost. In addition, the placement of dredged and/or fill material into jurisdictional wetlands is regulated by the Corps under Section 404 of the CWA. Construction activities that could result in direct adverse impacts include: placement of permanent roadway fill, construction of retaining walls, construction of bridge piers, installation of culverts, construction of temporary haul roads, construction of borrow pits or stockpile sites, stream channelization, and others.

The extent of direct wetland impacts of the 2002 Preferred Alignment's road construction activities associated with the Wildwood to Deer Creek State Park Segment, per habitat type, are summarized in Table 4-14.

Table 4-14. Wetland Impacts per Habitat Type.

WETLAND HABITAT TYPE	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
Palustrine Forested (PF)	0.05 hectare (0.12 acre)	0.00 hectares (0.00 acres)
Palustrine Scrub/Shrub (PSS)	0.22 hectare (0.55 acre)	0.18 hectare (0.44 acre)
Palustrine Emergent (PEM)	0.01 hectare (0.03 acre)	0.52 hectare (1.29 acres)
Riverine - Upper Perennial (PER)	0.34 hectare (0.84 acre)	0.07 hectare (0.17 acre)
Open Water	0.00 hectares (0.00 acres)	0.00 hectares (0.00 acres)
Total	0.62 hectare (1.54 acres)	0.77 hectare (1.90 acres)

The 2002 Preferred Alignment would impact several small isolated wetlands but would not impact riverine habitat associated with the Provo River, whereas the 1989 SEIS Alignment would impact riverine habitat associated with the Provo River. The only riverine habitat that would be affected by the 2002 Preferred Alignment is associated with Deer Creek. Linear length of riverine impacts for the 1989 SEIS and 2002 Preferred Alignments are summarized in Table 4-15.

Table 4-15. Linear Length of Riverine Impacts.

RIVERINE TYPE	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
Upper-Perennial	462 meters (1,516 feet)	126 meters (413 feet)
Intermittent	25 meters (82 feet)	150 meters (492 feet)
Total	487 meters (1,598 feet)	276 meters (905 feet)

Indirect Impacts

Indirect impacts are also the result of site-specific physical alterations, but they could occur in areas that are physically distant from direct impacts or later in time. Indirect impacts are usually foreseeable; however, the extent and magnitude of indirect impacts may not be predictable.

Therefore, this evaluation provides examples of indirect impacts but does not attempt to quantify the extent of indirect impacts.

Examples of indirect wetland impacts that could occur as a result of road construction activities include, but are not necessarily limited to, the following:

- sedimentation and siltation of wetland and riverine habitats situated down-gradient of earthmoving activities,
- erosion (i.e., gullying) of wetlands cleared of vegetation for roadway construction,
- head cutting resulting from the installation of culverts;
- effects to local hydrology resulting from earthmoving activities and/or vegetation removal, and
- shifts in the species composition of wetland plant communities resulting from the alteration of local hydrology or vegetation.

Appropriate implementation of the BMPs discussed above under Water Resources is expected to preclude the occurrence of any of the above impacts as the result of the Project.

Past Mitigation Measures

The following mitigation measures were implemented as part of past U.S. Highway 189 (US-189) reconstruction phases. Mitigation measures that would be implemented as part of the Wildwood to Deer Creek State Park Segment are identified in the Mitigation Measures section at the end of this chapter.

Murdock Diversion to Upper Falls Segment

Reconstruction of this segment of US-189 was completed in 1994. Highway construction resulted in impacts to approximately 1.86 hectares (4.60 acres) of jurisdictional wetlands (Anderson 1999). A mitigation plan for wetland loss (Shapiro 1989e) was designed and submitted to the Corps in August 1989. This plan proposed the reconstruction of 2.06 hectares (5.10 acres) of wetlands on 11 sites. As of spring 1999, 7 of the 11 proposed wetlands were constructed. These seven constructed wetlands totaled approximately 2.06 hectares (5.09 acres). Of these seven wetlands, six wetlands comprising 1.83 hectares (4.53 acres) of mitigation were successful. A successful wetland is defined by three indicators: hydrophytic vegetation, hydric soils, and hydrology (Anderson 1999). Wetland monitoring in this segment is complete (Anderson 1999, Carter 2000). The Corps has determined that, when successfully established, a portion of the excess wetland acreage constructed at the Bullock Property (see the Upper Falls to Wildwood Segment below) will compensate for the unsuccessful wetland mitigation in the Murdock Diversion to Upper Falls Segment (Carter 2000).

Upper Falls to Wildwood Segment

Reconstruction of this segment of US-189 was completed in 2000. Highway construction resulted in impacts to approximately 0.12 hectare (0.30 acre) of jurisdictional wetlands (Anderson 1999). A mitigation plan for wetland loss (Shapiro 1989e) was designed and submitted to the Corps in August 1989. This plan proposed the reconstruction of 2.58 hectares (6.37 acres) of wetlands on three sites. These three sites are the Bullock Property mitigation site (2.50 hectares [6.17 acres]), which is the former staging site for construction of the Upper Falls to Wildwood Segment; and two Recreation Path mitigation sites (0.04 hectare [0.09 acre] and 0.04 hectare [0.11 acre]).

The constructed Bullock Property mitigation site totals 3.16 hectares (7.80 acres) (Anderson 2000). As of September 2000 this site was developing in a manner acceptable to the Corps (Carter 2000). The two Recreation Path mitigation sites were also constructed and total approximately 0.08 hectare (0.20 acre). Both Recreation Path sites successfully meet all three wetland indicators (Anderson 1999, Anderson 2000). The Bullock Property and two Recreation Path sites will continue to be monitored in the future.

Wildwood to Deer Creek State Park Segment

Coordination with the Corps has resulted in the determination that the 2002 Preferred Alignment would be the least damaging, practicable alternative under the section 404(b)(1) guidelines of the CWA. Although reconstruction of this segment of US-189 has not been completed, the planned highway reconstruction would impact 0.77 hectare (1.90 acres) of jurisdictional wetlands (Anderson 1999). A mitigation plan for wetland loss was designed and submitted to the Corps as part of the 1995 Re-evaluation (BIO-WEST 1995), and a permit was issued. This plan proposed the reconstruction of 0.77 hectare (1.90 acres) of wetlands on two sites, Parts A and B, at Deer Creek. When constructed, Deer Creek Part B would consist of 0.52 hectare (1.3 acres) (Anderson 1999). A wetland totaling 0.24 hectare (0.60 acre) was proposed under Part A, and a 0.28-hectare (0.70-acre) wetland was constructed. This mitigation was not successful because of a lack of hydrology (Anderson 1999). However, UDOT and the Corps have determined that the riparian mitigation at Deer Creek Part A is successfully established and requires no further monitoring (Anderson 2000, Carter 2000). The Corps has determined that, when successfully established, a portion of the excess wetland acreage constructed at the Bullock Property (see the Upper Falls to Wildwood Segment above) will compensate for the unsuccessful wetland mitigation at Deer Creek (Carter 2000). Because construction of the haul road only realized 0.3 hectares (0.75 acres) of the impacts anticipated, a new permit will be obtained to cover the 0.47 hectares (1.16 acres) of wetland impacts associated with the remaining construction of the highway and the restoration of lower Deer Creek. The Corps has informed UDOT that no additional mitigation will be required.

Fisheries

The 2002 Preferred Alignment would not have direct effects on the Provo River fishery. However, there would be potential minor indirect effects as a result of runoff associated with construction activities. Implementation of the 2002 Preferred Alignment would have minor direct and indirect effects on the Deer Creek fishery. Approximately 100 meters (330 feet) of Deer Creek would be impacted. Based on an average channel width of 3.5 meters (11.4 feet), the total area of stream potentially impacted would include 0.04 hectare (0.09 acre). This would result in a loss of 30.1 habitat units (HUs) for brown and rainbow trout in Deer Creek. However, the Project will include the restoration of the lower portion of Deer Creek with associated improved channel configuration and aquatic habitat, which would result in a net positive benefit to the resource. In comparison, the 1989 SEIS Alignment would not impact Deer Creek or the fishery resources contained therein. However, the 1989 SEIS Alignment would impact fishery resources associated with the Provo River. A total area of 0.34 hectare (0.84 acre) along the Provo River would be impacted by the 1989 SEIS Alignment, whereas the 2002 Preferred Alignment would affect none.

Threatened, Endangered, and Candidate Species

The Provo River in Utah County is critical habitat for the endangered June sucker (*Chasmistes liorus*). The 2002 Preferred Alignment between Wildwood and Deer Creek State Park would not impact the Provo River in either Utah or Wasatch County. Therefore, direct impacts to June sucker would be unlikely. The major threat to June sucker habitat from highway construction would be silt drifting downstream while fry are still in the river (FHWA 1989). This is not anticipated to be a problem since anticipated silt loads during construction would not exceed those occurring during normal runoff events (FHWA 1989). In this regard, an approved SWP3 will still be developed and implemented during construction (see the Mitigation Measures section of this chapter).

Land Use

Land use impacts are defined in terms of right-of-way (ROW) acquisition requirements, consistency with land use plans, and conflicts with public services and utilities. Impacts would only occur where the highway conflicts with existing land uses.

Land Use Impacts within the US-189 Corridor

Both the 1989 SEIS Alignment and the 2002 Preferred Alignment would traverse unincorporated private lands within Wasatch County and BOR lands. For both alignments, additional properties would be acquired to accommodate the new highway alignment, extra work spaces, and equipment and material storage areas. Table 4-16 shows the expected amount of land required for ROW and cut and fill operations for the 1989 SEIS and 2002 Preferred Alignments. Actual acreage of impacted land may vary and will depend upon final design.

Table 4-16. Right-of-way (ROW) Requirements, Wildwood to Deer Creek State Park.

LAND TYPE	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT
Total	Approximately 12.5 hectares (31 acres)	Approximately 26.3 hectares (65 acres)

The 2002 Preferred Alignment would not affect existing platted lots within Canyon Meadows. Regarding the BOR housing area, BOR intends to retain ownership of the housing area below the dam and continue to lease it for use by Deer Creek State Park employees (Liljegren 2000). A new access road to the housing area would be constructed from an intersection near the Utah Power and

Light sub-station, proceed northeast between the HVHR and the old highway, under the existing HVHR overpass, and beneath the new highway structure over the HVHR. In addition, extensive coordination with BOR has occurred and would continue to ensure proposed construction would not conflict with activities outlined in the Deer Creek Reservoir Resource Management Plan.

Growth and development in Wasatch County is controlled by the Wasatch County General Plan (adopted in 2001) and implemented by the Wasatch County Planning, Zoning, and Development Code (adopted in October 2002). In addition to the relatively restrictive Code and its various zones (see Wasatch County Zoning Map, Appendix F), larger scale proposed developments are further constrained by the use of Overlay Zones with additional restrictions (see an example ordinance and restrictions in Appendix F) in the form of a conditional use process, which defines density based on a physical constraints analysis and a No Tolerance stance against any type of environmental degradation. Wasatch County has been very willing to enforce its zoning constraints, as evidenced by its restrictions on and litigation with the Canyon Meadows development. As a result, development in the general area is highly controlled and any potential environmental impacts are very closely regulated and mitigated.

According to the General Plan, private property represents 30.1 percent of the total area of Wasatch County. Of this amount, 89.7 percent exists in parcels greater than 65 hectares (160 acres) which are highly regulated by the plan and subject to stringent environmental constraints. Within the highway corridor in Provo Canyon, other than the existing Canyon Meadows development, the small amount of private property present is subject to the restrictions of the P-160 Zone as described in Chapter 3, and thus very limited development is possible. As noted above, these restrictions in addition to the physical constraints of the canyon essentially preclude further private development and attendant environmental effects.

Some agencies have expressed concern that growth and development in the highway corridor and other areas served by the improved highway will result in significant indirect and cumulative impacts to aquatic and terrestrial resources because of increased access resulting from the Preferred Alternative. In reality, very little if any additional growth will occur in the corridor because of the combination of limited private ownership, physical constraints, and restrictive zoning recently implemented throughout the entire corridor and the rest of Wasatch County. As indicated on the Zoning Map of Wasatch County (Appendix F), the entire corridor is zoned as P-160. This zoning was adopted on October 28, 2002, and is focused on limiting development in environmentally sensitive and remote areas. The actual code for this zone is provided in Appendix F.

No areas will be given access for development as the result of the Project that do not already have access. Other than the remaining platted lots in the Canyon Meadows development, which are subject to Wasatch County approved for building permits, no growth plans for the highway corridor are in place, and none are expected, because nearly all private property in the canyon is presently developed to the extent possible, and no new private property has or will become available. No infrastructure to support further growth is planned anywhere within the corridor. It should also be noted that the existing physical constraints along the corridor (mountainous terrain, steep slopes, and adjacent river and railroad) effectively preclude nearly all further development. Although the

Project Area includes high natural resource values, its human developmental value is quite low for the reasons noted. Based upon the above discussion, it is clear that there is no causal linkage between the highway, growth, and development in the Project Area.

Land Use Impacts outside the US-189 Corridor

As noted above, Wasatch County zoning and physical constraints are expected to limit or preclude any additional development in the Provo Canyon highway corridor itself. By contrast, the upper Heber Valley of Wasatch County and adjacent Summit County has and continues to experience considerable growth, as discussed in the draft document. Summit County, particularly the Park City area, has experienced rapid growth for some time and has developed an exceptionally strong and capable planning process in response. That capability has been reproduced in Wasatch County, since the majority of issues and concerns are similar and often shared, and development and growth in Wasatch County has tended to be driven by that in Summit County.

Access to the great majority of developments in the upper Heber Valley occurs primarily from the Park City and Salt Lake Valley areas, as noted in Chapter 1, with only a minor component from the Utah Valley area via US-189, which is consistent with the presumption that Summit County and the Salt Lake City Wasatch Front drive Wasatch County development and growth. This further supports the position that improvements to US-189 will have very little effect on future growth and development in the Heber Valley.

The possibility of other planned and likely developments outside of the Project Area that might have effects on land use and the environment has also been raised as a concern. An example of such planned development is that of the Victory Ranch, proposed for a location off State Road 32 near the town of Frances, located almost on the Wasatch / Summit County border approximately 10 miles east of Jordanelle Reservoir. That development, as well as several others in the general area of the reservoir (Deer Valley Lakeside, Tuhay Ranch, Bonanza Flats, Wolf Creek Village, and North Village) are included in one of several Wasatch County Overlay Zones (see Wasatch County Zoning Map, Appendix F) with additional developmental restrictions committed to by the developers as discussed below. As an example of zoning restrictions in these areas, the code for the Jordanelle Basin Overlay Zone is provided in Appendix F. A map of Surface Management Responsibility for Wasatch County lands is also shown in Appendix F. Cumulative impacts from these developments are addressed under Jordanelle Dam Construction.

Compliance with Project Area Land Use Plans

Current land use plans that apply to the Project Area are: the Wasatch County General Plan for 2001 to 2016 (Wasatch County 2001); the updated Wasatch County planning, zoning, land use, and development codes (Wasatch County 1997); the Wasatch County zoning map (Wasatch County 1999); the Provo Canyon Scenic Byway Plan (BIO-WEST et al. 2000); and the Deer Creek Reservoir Resource Management Plan (Bear West 1998).

With the implementation of the 2002 Preferred Alignment, much of the highway segment from Wildwood to Deer Creek State Park would traverse through two Wasatch County land use zones: Watershed Conservation and Recreation Forestry, as determined by Wasatch County's zoning map

(Wasatch County 1999). Implementation of the 2002 Preferred Alignment would be in accordance with both zoning designations (Kohler 2000).

Wasatch County expects the trend of growth it has been experiencing over recent years to continue and acknowledges and supports US-189 improvements in the Wasatch County General Plan (Wasatch County 2001). Although the county is anticipating and encouraging growth as supported by the highway, it is also planning to deal with any growth issues; including access to properties, additional local traffic, and sewer and water availability. The Wasatch County Comprehensive Plan has recently been revised and addresses many of the issues. The new P-160 zone to be adopted by Wasatch County will greatly restrict growth in the Project Area itself.

In the area where the 2002 Preferred Alignment would move away from the Provo River, some highway segments would be abandoned and would become available for other uses. All of the land adjacent to the river is currently within UDOT's ROW, and most of the land farther up-slope is privately owned, with a small portion west of the Deer Creek Campground under BOR ownership. The area along the Provo River would likely remain undeveloped largely because of minimal access once the new highway alignment is completed and because of the Interlocal Agreement and Memorandum of Agreement (MOA) signed by local governments in the *Provo Canyon Scenic Byway Corridor and Watershed Management Plan* (BIO-WEST et al. 2000).

Prime and Unique Farmland

The 2002 Preferred Alignment would not impact any category of important farmlands (Broderson 2000). The 1989 SEIS Alignment would impact 0.4 hectare (1.0 acre) of prime and unique farmland (Broderson 2000).

Visual Resources

Effects on the visual environment are defined as changes that would likely occur as a result of implementing the proposed Project segment, resulting in changes to the visual environment would not be in accordance with existing visual quality. Impacts were measured in terms of four factors: cut and fill heights and lengths, immediate visual intrusion in the Canyon Meadows area, disturbance within and near the Provo River and its associated riparian areas, and the intrusion of facilities, such as walls and bridges, into the viewscape. Other aspects factored into the determination were compatibility with the existing environment, resulting landscape character, and the potential for revegetation success. The design elements discussed in the following sections were developed for the 1995 Re-evaluation (BIO-WEST 1995). Further refinement during final design is anticipated to result in minimization of the impacts noted below.

This evaluation of impacts to Provo Canyon's visual quality also includes consideration of the Scenic Byway system. The segment of US-189 from the mouth of the canyon to its intersection with US-40 in Heber City was designated a State Scenic Byway in 1990 because of its high recreational, natural, and scenic qualities. These special qualities are described in detail in the *Provo Canyon Scenic Byway Corridor Management Plan* (BIO-WEST et al. 2000). One of the purposes of the plan was to assess the potential benefits of pursuing a National Scenic Byway designation for the portion of US-189 in Provo Canyon. Visual quality is a major element for such establishment. Therefore, it is likely in the best interest of all parties that visual impacts to Provo Canyon from 2002 Preferred Alignment construction be minimized and mitigated to the extent practicable.

In general, both the 2002 Preferred Alignment and 1989 SEIS Alignment would result in substantial cut and fill heights and lengths on the lower and upper portions of the Project. The 2002 Preferred Alignment would include a large fill along the face of Deer Creek Dam. However, compared with the 1989 SEIS Alignment, the 2002 Preferred Alignment would greatly reduce the potential for impacts to the Provo River and its associated riparian areas. Overall, the *Provo Canyon Scenic Byway Corridor Management Plan* (BIO-WEST et al. 2000) found that the Proposed Action would not degrade scenic qualities of Provo Canyon to the degree that it would prevent the highway from being designated a National Scenic Byway. The plan also determined that the scenic driving experience through Provo Canyon would be improved significantly by the Proposed Action. The following sections provide detailed discussions on the potential visual impacts of the Wildwood to Deer Creek State Park Segment. Mapping for the entire segment is provided in Appendix E. The details of this segment are based on the preliminary design developed in the 1995 Re-evaluation (BIO-WEST 1995). Further refinement during final design is anticipated to result in minimization of the impacts noted below.

Section 1

Cut heights associated with the 2002 Preferred Alignment would extend to 34 meters (112 feet) above the new roadway, with an average height of 15 meters (49 feet) throughout Section 1. Cut heights associated with the 1989 SEIS Alignment would extend to 37 meters (120 feet) in height, with an average height of 18 meters (60 feet) throughout Section 1. The 1989 SEIS Alignment would require a 76-meter (250-foot)-long retaining wall adjacent to the Provo River. The 1989 SEIS Alignment would impact approximately 462 meters (1,515 feet) of the Provo River with the placement of fill material directly into the river. Much of the remainder of the 1989 SEIS Alignment within Section 1 would result in fill being placed within 9 meters (30 feet) of the Provo River.

Section 2

Three retaining walls would be required to prevent fill from impacting the Provo River and the HVHR through the first portion of Section 2 for the 2002 Preferred Alignment. These walls would be approximately 305 meters (1,000 feet), 61 meters (200 feet), and 350 meters (1,150 feet) long, respectively. Each wall would have a maximum height of 8 meters (26 feet), 2 meters (7 feet), and 12 meters (40 feet), respectively. In certain areas, these walls could come within 12 meters (39 feet) of the HVHR. A 396-meter (1,300-foot)-long tieback wall would also be required to prevent rockfall at the top of the cut slope associated with the 2002 Preferred Alignment. An approximate 500-meter (1,640-foot) cut, with a maximum height of 20 meters (66 feet), would occur near Canyon Meadows with implementation of the 2002 Preferred Alignment. The roadway through this portion of Section 2 was designed to direct up-canyon traffic headlights away from Canyon Meadows and to reduce the visibility of the roadway. Visual impacts specific to Canyon Meadows residents are discussed below under Socio-economics, Quality of Life.

Implementation of the 1989 SEIS Alignment would result in a 203-meter (665 foot)- and a 355-meter (1,165 foot)-long cut slope with maximum cut heights of 27 meters (90 feet) and 18 meters (60 feet), respectively. The 1989 SEIS Alignment would include two bridges at the Horseshoe Bend area approximately 152 meters (500 feet) and 107 meters (350 feet) long, respectively. These bridges would be approximately 15 meters (50 feet) above the Provo River. For the 1989 SEIS Alignment, two retaining walls, one approximately 152 meters (500 feet)-long and one approximately 457 meters (1,500 feet)-long, would be required. Each of these retaining walls would be located within 3 meters (10 feet) of the HVHR for extended distances. In addition, the 1989 SEIS Alignment would directly impact the HVHR in four separate areas, resulting in the modification of track alignment.

Section 3

Implementation of the 2002 Preferred Alignment in Section 3 would result in creation of a roadway cut near Deer Creek Campground that would be approximately 250 meters (820 feet) long with a maximum height of 31 meters (102 feet). The 2002 Preferred Alignment would follow the existing highway alignment to the Weeks Bench area, where it would be realigned towards the BOR dam tender's housing area to begin the climb across Deer Creek Dam. This area would require substantial fill approximately 24 meters (80 feet) high and 305 meters (1,000 feet) long. A new structure would be constructed to cross the spillway.

Continuing east, the previously planned, vertically split traffic lanes and large cuts along the south shore of Deer Creek Reservoir would be considerably reduced by use of the soldier pile walls. The final design effort will analyze alternatives that may eliminate the need for the snow shed over the roadway.

The 1989 SEIS Alignment would impact the HVHR because it would require removing the overpass itself and placing fill over the existing highway. Fill areas on either side of the bridge would require terraced retaining walls approximately 100 meters (330 feet) in length. A second and significantly larger bridge would be required in order to cross the Provo River to the slope along the south side of Deer Creek Dam. This bridge would have a length of approximately 253 meters (830 feet) and would be approximately 34 meters (110 feet) above the river. Continuing east, the 1989 SEIS Alignment would require three substantial cuts along the south shore of Deer Creek Reservoir. These cuts would have maximum heights of approximately 32 meters (105 feet), 95 meters (310 feet), and 61 meters (200 feet) each, with lengths of approximately 152 meters (500 feet), 253 meters (830 feet), and 355 meters (1,165 feet), respectively.

Section 4

Both the 2002 Preferred and 1989 SEIS Alignments in Section 4 would require similar cut and fill areas that are not expected to be substantial in size. Each alignment would include a deer underpass between the east (i.e., public) entrance to Deer Creek State Park and Main Creek at Wallsburg Bay (see the Mitigation Measures section of this chapter). Deer-proof fencing will be installed along both sides of the new highway clear zone, as described in the Mitigation Measures section of this chapter. No bridges or retaining walls are anticipated for Section 4.

Recreation Resources

Impacts to recreation resources are defined as actions that would decrease the number of recreation opportunities or negatively affect visitation or recreation facilities. Some concern has been expressed that the improved recreational access and presumed use anticipated from implementation of the Project may also result in adverse impacts to some users in terms of the recreational experience. However, recreational access to most of the canyon will not be changed by the Project, since it will generally only be provided in those locations where access currently exists. Although improved angler parking will be included in the design, particularly where the existing highway is abandoned, use of the portion of the Provo River in the Project corridor for fishing is already very high and anglers seeking solitude and seclusion have long been required to utilize other locations or adjust their schedules to lower use times.

In terms of impacts to sensitive environmental resources resulting from improved access, as noted above no new areas will be made more accessible by the Project. In fact, access by anglers, formerly resulting in considerable impacts to riparian areas and stream banks, will be more controlled by the Project. Relative to sensitive wildlife species, the access limitations and physical constraints noted above will continue to preclude such effects, and have been closely coordinated with Federal and State resource agencies.

Developed Recreation Facilities

Heber Valley Historical Railroad (HVHR)

The 1989 SEIS Alignment would directly impact the Heber Valley Historical Railroad (HVHR) in four separate areas, resulting in the modification of track alignment. Under the 2002 Preferred Alignment, the HVHR would be affected only by minor disruption during construction of the new structure over the railroad. Any disruption to HVHR service is expected to be short in duration, thereby minimizing impacts to this popular attraction.

Provo-Jordan River Parkway Trail (Trail)

The potential extension of the Trail has been facilitated by this Project as mitigation and enhancement. The Trail is addressed in detail in this document, and a Preferred Alternative for the trail extension is presented.

Pedestrian and Bicycle Facilities

Use of the stabilized, paved roadway shoulders by pedestrians and bicyclists would be allowed under both the 1989 SEIS and 2002 Preferred Alignments.

Deer Creek Campground

Access to the Deer Creek Campground would not be affected by the 1989 SEIS or 2002 Preferred Alignment, since both alignments would be similar to the existing highway alignment near the campground. Traffic noise at the campground would tend to decrease slightly under the 2002 Preferred Alignment, since it is further from the campground in some areas.

Deer Creek State Park
The boundary and twelve Management Areas of Deer Creek State Park are shown on Figure 4-1. The 1989 SEIS Alignment would impact 1.09 hectares (2.70 acres) of land, adjacent to the existing highway in the Main State Park Area, managed by Deer Creek State Park but not utilized for recreation, and the 2002 Preferred Alignment would not affect this area. The 2002 Preferred Alignment would impact approximately 19.18 hectares (47.40 acres) of land over which BOR has retained jurisdiction for non-recreational use. The required land is undeveloped and located below Deer Creek Dam and adjacent to the dam near the reservoir, and is within an area classified as BOR Primary Jurisdiction Zone (Figure 4-1) according to the Deer Creek Reservoir Management Plan (Bear West 1998). The BOR Primary Jurisdiction Zone is managed to benefit water operations and restricts usage to those of official capacity. Public recreational activities are not permitted in the BOR Primary Jurisdiction Zone and the area is not considered part of the Park. Therefore, no existing recreational facilities or opportunities would be lost under either the 1989 SEIS or 2002 Preferred Alignment, and impacts to recreation opportunities are not expected.

Unimproved Recreation Facilities
The 2002 Preferred Alignment would entail some loss of informal highway turnouts; however, new or modified vehicle turnouts would be created. A turnout between Horseshoe Bend and the Utah Power and Light substation, where the new alignment would be relocated away from the Provo River, would be replaced by other access. The relocation of the 2002 Preferred Alignment away from the Provo River (between Horseshoe Bend and the Utah Power and Light substation) would improve recreational opportunities along this reach of the river as a result of decreased traffic noise and other disruptions associated with high volumes of traffic.

Adjacent Recreational Opportunities
Neither the 1989 SEIS Alignment or the 2002 Preferred Alignment would be located on lands owned by the Uinta National Forest, Wasatch Mountain State Park, Mount Timpanogos Wilderness Area, or Sundance Ski Resort. Therefore, direct adverse impacts to these areas would not occur under either alignment. Recreational activities on these adjacent lands would also not be indirectly affected by either alignment. The improved highway and resultant level of service may provide beneficial indirect impacts in terms of improved accessibility to these areas, but could result in greater use, which some users would consider negative.

Socio-economics

Socio-economic impacts are those that affect the existing social structure and/or the existing economic structure of the communities within the Project corridor. Impacts can either be direct effects on these structures or indirect effects resulting from primary impacts on other resource components such as farmlands, wetlands, and land uses. Impacts to the local socio-economic system include disruption or substantial change in existing social patterns, an increase in public dissatisfaction to levels that generate conflict or organized response, permanent displacement of residents or users of the area (i.e., relocation), and disruption of or substantial change in existing economic patterns.

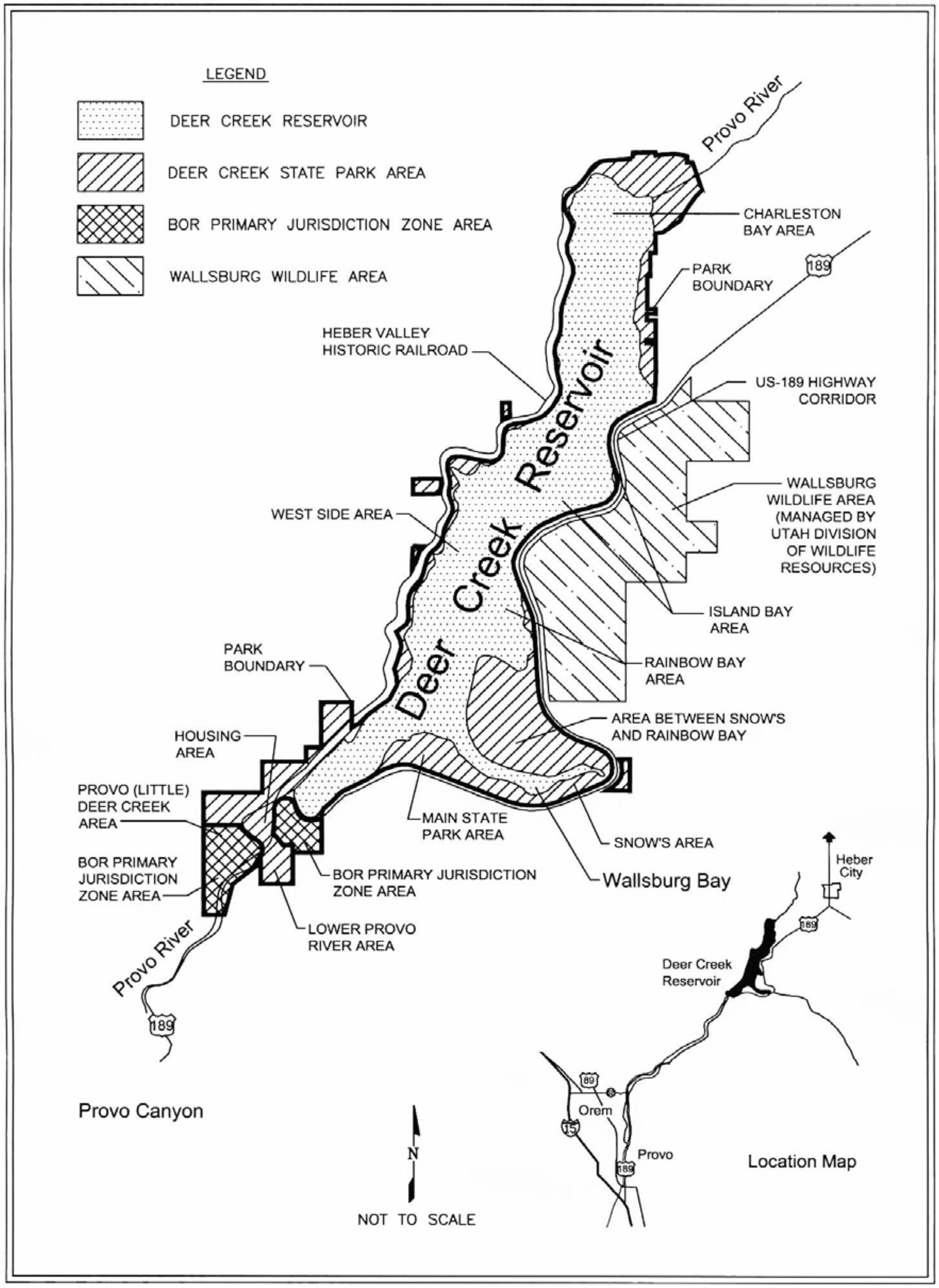

Figure 4-1. Deer Creek State Park Boundary and Management Areas.

Economic Growth

Highway improvement projects are generally associated with economic growth in the surrounding communities. An improved roadway, greater travel efficiency, increased use from induced and diverted traffic, reduced delays, and reduced accident rates will add to the economic growth of the region. However, the most significant factor resulting in economic growth in the region is simply the high population growth. Utah and Wasatch Counties experienced 40 and 52 percent population increases, respectively, between 1990 and 2000 (U.S. Census Bureau 2000). Both counties are predicted to experience similar growth rates in future years. Therefore, much of the economic growth is expected to occur regardless of the alignment chosen or whether the highway is improved or not. See the detailed discussion under Land Use above in this regard.

Quality of Life

Canyon Meadows

Since the 2002 Preferred Alignment would move closer to the Canyon Meadows development in the canyon than the existing highway, some Canyon Meadows residents have expressed concerns as to a reduction in perceived quality of life. As a result, UDOT has coordinated closely with the community since the development of the new alignment.

The following is a brief summary of that coordination:

- Meeting held October 27, 1994 on site to view new alignment and discuss concerns.
- Meeting held December 1, 1994 on site to respond to questions raised during previous meeting.
- Meeting held February 2, 1995 on site to discuss construction time frame and possible placement of berms.
- Meeting held March 22, 1995 with all canyon property owners to discuss the preferred alignment, schedule, and access options.
- Meeting held June 17, 1995 with Canyon Meadows Homeowners Association (CMHA) to provide an update on alignment and schedule.
- Meeting held November 13, 1995 at Canyon Meadows Clubhouse to further discuss the status of the Upper Falls to Wildwood Segment, scheduling, landscaping, and the haul road.
- UDOT Geotechnical Division geologist Leslie Heppler has continued coordination through present with CMHA relative to stability and data collection.

- CMHA representative Victor Orvis was invited to be a member of the new Cooperating Advisory Team for the Project in March 2000 and has subsequently attended the majority of the CAT meetings. Copies of previous technical analyses and environmental documents provided for CMHA review.

- Meeting held April 11, 2000 with CMHA representatives at UDOT Region 3 Headquarters to discuss concerns relative to the Project.

- UDOT agreed in a March 26, 2001 memo to the CMHA to read their inclinometers on an annual basis.

- Copy of geotechnical peer review study provided to CMHA in July 2001.

- CMHA representative Victor Orvis participated as a member of the aesthetics evaluation team for the selection of final wall treatment.

- UDOT designers discussed CMHA concerns at Orem Public Hearing in October 2002.

- Meeting with CMHA set up for December 12, 2002; rescheduled to January 11, 2003; and canceled by CMHA on January 3, 2003.

- UDOT designers met with CMHA water representative on March 12, 2003 to discuss water piping issues.

- UDOT anticipates holding design workshop with CMHA late April or May.

Primary issues raised by the Canyon Meadows community during scoping and subsequent coordination have centered on noise, visual intrusion from the highway and vehicle lights, localized wildlife disruption, geotechnical stability, and anticipated lifestyle and security changes. In response to these concerns, a variety of analyses and evaluations have been conducted in conjunction with the current effort.

- An updated noise analysis was conducted (see Noise section for details) which indicated that the 2002 Preferred Alignment would not increase noise levels at any sensitive receivers to the level that noise abatement measures would be required.

- Visual simulations indicate that residents would be able to see only a very small section of the new highway at one location in the viewshed (see Photo 4-1 at the end of this chapter, which was taken from the vicinity of the Canyon Meadows clubhouse), and it would be at a very small scale due to the considerable distance away. Likewise, an additional simulation of two vehicles driving toward Canyon Meadows at night indicates a very limited and low intensity view of vehicle headlights from the same location (see Photo 4-2 at the end of the chapter).

- The UDWR reviewed (see Agency Coordination letters, Appendix G) the potential effects of the highway on local wildlife, and determined that those species would not be impacted in any substantial way. The agency is working closely with the highway designers to locate appropriate mitigative fencing and highway crossings.

- Previous and current geotechnical studies, as well as an independent geotechnical peer review, indicate that the 2002 Preferred Alignment would be more stable than the 1989 SEIS Alignment on the existing highway (see Earth Resources section and Chapter 2).

- The new highway would be closer to the community and some highway users currently unaware of its presence would become aware of its location. However, the entire highway ROW will be fenced and all accesses to the community will remain locked and gated.

Thus, impacts to the Canyon Meadows development from the construction of the highway as proposed have been carefully considered.

Overall Project Area

In each segment of the Project, the 2002 Preferred Alignment would result in fewer traffic delays than would the 1989 SEIS Alignment. For some Project Area residents, the perceived quality of life would be directly improved as a result of this improved traffic flow, as well as improved accessibility for police and fire protection. Others would possibly perceive a reduction in quality of life as the result of closer traffic and greater exposure to the general public. Motorists and commuters driving through the Project Area would also sense an improvement because of smoother traffic flows. Regarding regional and interstate commerce through Provo Canyon, fewer traffic delays would result in less economic impact. As noted in Chapter 1, the Project would result in some minor amounts of induced and diverted traffic and would thus likely result in some local disruptive effects on residents and local travel in the Orem, Provo, and Heber City areas. However, as noted above, local economic benefits would counter the impacts.

As noted above under Land Use, the Wildwood to Deer Creek State Park Segment is not expected to effect further growth and development in the corridor or the general area. Public perception of indirect and cumulative impacts is consistent in this regard. Although extensive public comment was received during scoping meetings and the public hearings, no comments were directed at such concerns. The great majority of comments were either supportive of the Project in all aspects, or expressed concerns for direct impacts to Canyon Meadows residents.

Implementation of the 2002 Preferred Alignment would not result in any residential relocations. Implementation of the 1989 SEIS Alignment would result in the relocation of at least two residences near the entrance to Canyon Meadows. In addition, the 1989 SEIS Alignment would impact the HVHR tracks. Either of these alignments could temporarily affect the railroad's operation, thus economically adversely impacting this local business for a short time.

Construction Impacts

Temporary or construction-related impacts that would affect the social structure of the Project Area would be disruptions in the normal day-to-day life patterns of local residents and the traveling public. These short-term construction impacts would occur under either the 1989 SEIS or 2002 Preferred Alignment and could include impacts such as traffic delays, noise, air quality, and increased truck traffic in the Project Area and at segment termini. Access to recreation areas and residences within the Project Area would be maintained, although current access would require realignment.

Because the Project has been and continues to be constructed in phases (due to funding availability) some long-term construction impacts to the public may occur, as discussed in Chapters 1 and 2. These could include safety issues where phases start and stop; extended periods of noise, pollution, and disruption; and increased cost over time.

Environmental Justice

As specifically required by Executive Order 12898 regarding Environmental Justice, two minority renter-occupied residences have been identified within the Project Area near the existing Canyon Meadows entrance, according to the 2000 U.S. Census. The 2002 Preferred Alignment would not impact these households or result in any residential or business relocations, whereas the 1989 SEIS Alignment would result in the relocation of the two households. Therefore, the 2002 Preferred Alignment would not impact low-income or minority populations, and the requirements of Title VI and all Orders and other Federal direction related to Environmental Justice have been met.

Cultural Resources

In accordance with Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, efforts have been made to consider the effect the Project would have on historic, archaeological, and paleontological resources. Based on inventories conducted by Sagebrush Archaeological Consultants (Weymouth et al. 1995), Brigham Young University's Office of Public Archaeology (BYUOPA 1995), and Alpine Archaeological Consultants (Reed 2001), 12 properties in the Project Area have been identified as eligible for the National Register of Historic Places (NRHP) as defined by 36 Code of Federal Regulations (CFR) 60.4 (BYUOPA 1989, Southworth 1995, Skinner 2000). These 12 properties are identified in Chapter 3.

The UDOT determined that 6 of the 12 eligible properties are located within the area of potential effect (APE) (Southworth 1995), as defined by 36 CFR 800.4(d). These six properties include the following:

- two historic residences (BLDG-4 and BLDG-5),
- the HVHR Overpass (42WA114),
- the Deer Creek Reservoir Dam Complex (DC6),

- the Weeks Bench Archaeological Site (42WA87), and
- a prehistoric campsite (42WA42).

The 1989 SEIS Alignment would adversely effect the two historic residences and the HVHR Overpass (FHWA 1989a). The UDOT and Federal Highway Administration (FHWA) have determined that the 2002 Preferred Alignment would have an adverse effect on the Deer Creek Reservoir Dam Complex (DC6) and prehistoric site 42WA42 (Skinner 2000) and therefore, a finding of adverse effect has been determined for this Project. These determinations and findings are detailed in the Section 4(f) analysis included in Chapter 5. The Utah State Historic Preservation Office has concurred with FHWA/UDOT's determinations through an MOA included in Appendix G. Although the Advisory Council on Historic Preservation (ACHP) participated in the MOAs executed for this Project segment in 1989 (FHWA 1989b) and 1995 (UDOT 1995), the ACHP declined to participate in the current, updated MOA for the Wildwood to Deer Creek State Park Project Segment. No paleontological resources within the APE would be affected by the Project.

Noise

This section describes the potential noise impacts to sensitive receivers adjacent to the proposed roadway segment between Wildwood and Deer Creek State Park. Previous noise studies were reviewed, replicated, and updated using design information and projected traffic levels from the *Provo Canyon Traffic Analysis* (Fehr & Peers 2000). Prior noise levels were predicted using the STAMINA 2.0 DOS-based traffic noise modeling software. Noise levels for this analysis were predicted for both the 1989 SEIS Alignment and the 2002 Preferred Alignment using FHWA's TNM version 1.1 noise prediction software, an enhanced, Microsoft® Windows®-based traffic noise modeling program. This software evaluates anticipated traffic volumes, vehicle types, vehicle speeds, traffic control devices, roadway geometry, screening provided by buildings, terrain features, and sensitive receiver locations. This information was used in the model to calculate future Project-related hourly equivalent sound level [Leq(h)] noise levels for the Project design year.

As part of this analysis, seven sensitive noise receivers were monitored for existing Leq(h) traffic noise levels in 2001 using a Quest Technologies —28 Dosimeter. These locations largely represent the most sensitive receivers, or those that would most likely affect residents or canyon users. To determine potential impacts, the locations of these receivers were entered into the TNM program, along with highway and traffic design information and adjacent land features. Design year noise levels were then predicted for the original 1989 SEIS Alignment and the 2002 Preferred Alignment. Comparisons were then made between existing (measured) noise levels for 2001, and predicted design year noise levels for both alignments. These noise level results are presented in Table 4-17.

Table 4-17. Existing and Predicted Hourly Equivalent Noise Levels [Leq(h)] for the Wildwood to Deer Creek State Park Segment of US-189 in Provo Canyon.

SITE	RECEIVER LOCATION	MEASURED dBA[a] [Leq(h)] [b]	PREDICTED DESIGN YEAR dBA [Leq(h)] FOR 2002 PREFERRED ALIGNMENT	PREDICTED DESIGN YEAR dBA [Leq(h)] FOR SEIS ALIGNMENT
1.	Deer Creek Dam	66.2	55.6	56.3
2.	BOR[a] Housing	47.2	55.9	55.0
3.	Berm by BOR Housing	61.5	57.5	59.6
4.	Campsite below Dam	52.7	59.6	59.3
5	Deer Creek Campground	53.4	51.9	52.7
6.	Canyon Meadows Office	56.6	54.4	52.8
7.	Hoover Housing Residences by Highway	61.3	58.0	Displaced by 1989 SEIS Alignment

[a] Decibel on the A-weighted scale.
[b] Equivalent sound level.
[c] Bureau of Reclamation.

Table 4-17 compares existing (measured) noise levels to determine if there are potential impacts from implementing the 2002 Preferred Alignment and the 1989 SEIS Alignment. According to the FHWA Noise Abatement Criteria (NAC), as explained in Chapter 3, an impact would occur if the predicted design year Leq approaches (is within 2 decibels [dB] on the A-weighted scale [dBA] of [65 dBA]) or exceeds the NAC (67 dBA), or substantially exceeds the existing Leq by 10 or more dBA.

For comparison purposes, Table 4-17 also gives predicted noise levels for the 1989 SEIS Alignment using the TNM model. Results are similar to those shown for the 2002 Preferred Alignment.

The nearest Canyon Meadows receiver at the Canyon Meadows office had a predicted Leq dBA of 54.4, which is a decrease from existing conditions since the roadway would be depressed through this area. A noise contour map focusing on the portion of the Canyon Meadows area where the 2002 Preferred Alignment would be closest to residences is shown in Figure 4-2. The map shows that noise levels continue to decrease moving away from the highway toward the residences and are well below the level of 65 dBA, at which noise abatement is required. The receiver near the residences along the existing highway had a measured dBA of 61.3, but because the 2002 Preferred Alignment is located further above these residences, the projected noise level at this receiver location is 58 dBA, which is below the current level and the noise abatement criteria level.

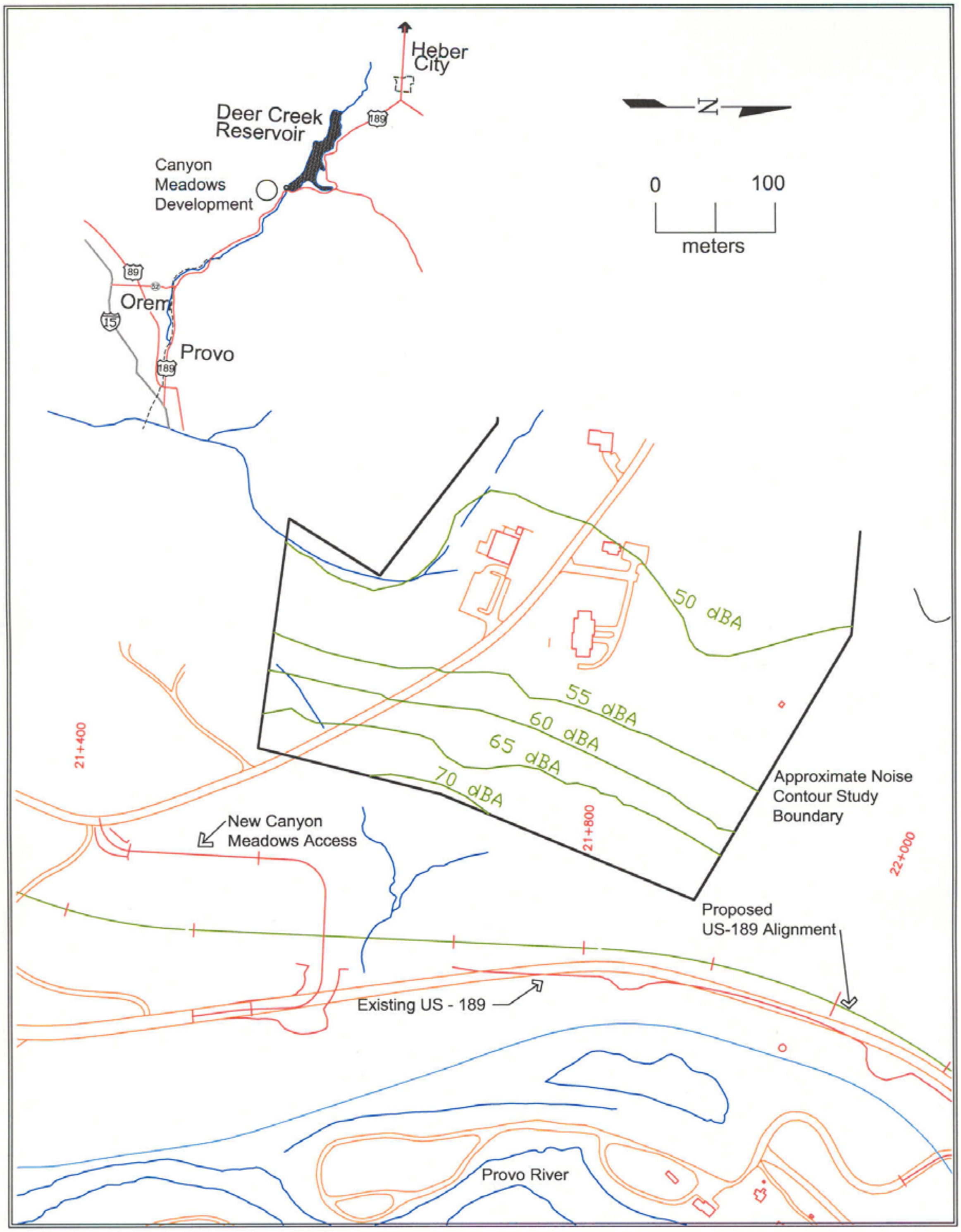

Figure 4-2. Noise Contour Map of the Canyon Meadows Area.

Based on results predicted by FHWA's TNM traffic noise model and the FHWA NAC, noise increases do not exceed criteria, and impacts to sensitive noise receivers are not anticipated from implementing the 2002 Preferred Alignment or the 1989 SEIS Alignment.

Air Quality

Wasatch County is currently classified as an attainment area for State and Federally listed pollutants (UDAQ 2002). In other words, Wasatch County has attained conformity with the National Ambient Air Quality Standards (NAAQS) and State standards for air pollution and localized increases in traffic, and construction of the new alignment would not change this classification. Utah County expects final air quality conformity in April 2003.

Conformity

Conformity to the State Implementation Plan and the Transportation Improvement Plan does not apply to the Wildwood to Deer Creek Segment of the Project because Wasatch County is an attainment area that currently lacks transportation control measures (i.e., traffic signals). As a result, the conformity procedures of 23 CFR 770 do not apply to this Project. However, it was determined that a careful review and evaluation should be performed for current and future carbon monoxide (CO) emissions associated with the Project segment of US-189. Determining NAAQS conformity for selected projects is completed using two computer models developed by the Environmental Protection Agency (EPA) and approved for use by FHWA and UDOT. The first model is the Mobile 5a-H Emissions Model (MOBILE5), which estimates mobile source emissions of hydrocarbons (HC), nitrogen oxides (Nox) and CO in grams per mile. The second model is the CAL3QHC Dispersion Model (CAL3QHC), which predicts CO or other pollutant concentrations from motor vehicles.

Methodology

The MOBILE5 and CAL3QHC computer models were used to predict CO emission levels during worst case-traffic and weather conditions for years 1999 and 2020. Traffic data for these two years were referenced from the Provo Canyon Traffic Analysis (Fehr and Peers 2000). Current conditions are represented by 1999, while 2020 represents the "design year" for the Project. Using the NAAQS guidelines current CO conditions were compared with those of the design year to determine whether the Project is likely to cause localized violations of the NAAQS. All modeling was conducted in accordance with the methodologies described in the *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections* (EPA 1995) and *Guidelines for Modeling Carbon Monoxide from Roadway Intersections* (EPA 1992).

Typical methodology for modeling traffic pollutant concentrations involves evaluation of stop-and-go traffic areas or intersections where idling traffic builds up. This is referred to as a "hotspot analysis." Because there are no such intersections in the Project Area, the analysis was performed with the "free-flow link" function of CAL3QHC. The free-flow link is used to analyze traffic that does not stop or is not interrupted by an intersection.

The CAL3QHC model only computes 1-hour CO concentrations. However, the EPA's NAAQS for CO include both 1-hour and 8-hour standards. Therefore, the 1-hour averages computed by CAL3QHC for the free flow links were converted to an 8-hour average through the following formula:

$CO_8 = CO_1 * 0.70 + BG_1$

where: CO_8 = 8-hour CO concentration in ppm
CO_1 = 1-hour CO concentration in ppm
BG_1 = 1-hour background CO concentration in ppm
0.70 = meteorological persistence factor

The one-hour background concentration for rural Utah is 1 ppm, as provided by the Utah Division of Air Quality. Moving vehicle winter CO emissions rates were obtained from the Mountainland Association of Governments (MAG) and their MOBILE5A model for Wasatch and Utah Counties.

Results

A segment of U.S. 189 approximately 580 meters (1,900 feet) in length for both the current alignment and the 2002 Preferred Alignment between Wildwood and Deer Creek Dam was selected to model for CO emission levels. A separate model run was not completed for the 1989 SEIS Alignment since traffic capacity for both the 2002 Preferred Alignment and the 1989 SEIS Alignment is the same. (Both alignments utilize four traffic lanes verses the existing roadway that utilizes two lanes.) Carbon monoxide levels were predicted adjacent to the roadway segment. Predicted levels were compared with the NAAQS for CO to determine if the Project is likely to cause violations of the NAAQS. The results are shown in Table 4-18. Based on this data, the current highway alignment is not contributing to any localized CO violations. Furthermore, neither the 2002 Preferred Alignment nor the 1989 SEIS Alignment would result in violations of the 1-hour or 8-hour NAAQS. The minor increases in traffic volume into Utah County from the Project have already been incorporated into the regional air quality modeling, and this would not produce any additional impacts.

Table 4-18. Predicted Carbon Monoxide (CO) Concentrations for the Proposed Action.

1999		2020		NAAQS	
Predicted 1-hour CO Level	Predicted 8-hour CO Level	Predicted 1-hour CO Level	Predicted 8-hour CO Level	1-Hour NAAQS	8-Hour NAAQS
0.40	1.28	0.40	1.28	35 ppm	9 ppm

Construction Impacts

Construction activities associated with either the 1989 SEIS Alignment or the 2002 Preferred Alignment would cause a short-term, localized degradation of air quality within the Project Area.

A temporary increase in vehicle emissions would be expected as a result of heavy equipment activity, hauling materials, and idling vehicles in the area. Additionally, fugitive dust would be generated by construction activities such as excavation, heavy equipment operation, and traffic in construction areas. Fugitive dust levels would vary depending on the level of activity, specific construction techniques, soil characteristics, and weather conditions. These would be controlled with standard construction specifications.

Truck Access

The use of US-189 through Provo Canyon by large trucks and those transporting hazardous waste has long been a controversial issue. Oversize and overweight trucks, including long, combination vehicles, are currently restricted from US-189 in Provo Canyon. However, vehicles carrying hazardous materials are not restricted at this time (R. Clasby 2001, pers. comm.). These truck restrictions would not be changed or impacted by implementation of either the 1989 SEIS or 2002 Preferred Alignment.

Any further restrictions on truck size or contents would be beneficial in terms of safety and potential environmental impacts (e.g., pollution from spills), but would require political approval at the state level and authorization from FHWA.

HIGHWAY RECONSTRUCTION: DEER CREEK STATE PARK TO HEBER CITY

This section presents the probable environmental consequences or impacts to the biological and human resources that would result from improving US-189 from Deer Creek State Park to Heber City. The goals of these analyses are to ensure that the design parameters and environmental considerations are appropriate and to determine the potential for significant impact to the physical, biological, and social environments as a result of Project implementation. Since the design for this segment of US-189 is the same as previously analyzed in the 1989 SEIS, the following discussion is intended to provide updated information. The direct, indirect, and cumulative impacts described are based on the existing conditions of each resource as presented in Chapter 3.

Wherever possible, quantitative estimates of impacts were measured. Where quantitative assessments were not practicable or available, qualitative assessments were made. Potential direct and indirect impacts are discussed under each affected resource component, and potential cumulative effects are disclosed in the Cumulative Effects section of this chapter. Impacts described in this chapter are based on the preliminary design of the Deer Creek State Park to Heber City Segment of US-189 as presented in the 1989 SEIS (FHWA 1989a). During final design, efforts will be made to reduce or eliminate such impacts. Information in the previous Highway Reconstruction portion of this chapter will not be duplicated in the following discussion.

Since this and other highway construction projects have been and would continue to be phased because of funding availability; safety, noise, air quality, and congestion impacts to the public may occur. Many of these impacts would transfer from the end of the recently completed Upper Falls to Wildwood Segment to the end of the Wildwood to Deer Creek State Park Segment. However, such impacts are expected to be reduced, since roadway geometrics and sight distance characteristics are better at this location than at the end of the previous segment.

Earth Resources

The 1989 SEIS describes the impacts the reconstruction of this segment of US-189 would have on earth resources, including approximately 500 linear meters (1,650 feet) of cut and fill where the highway crosses a hill above Deer Creek Reservoir, slope stability, and erosion potential (FHWA 1989a). The final design would include appropriate mitigation measures to address these impacts, consistent with those described in the 1989 SEIS (FHWA 1989a) and this document, including use of appropriate slopes for cut and fill areas, revegetation of areas of disturbed soils, and other measures to provide erosion control.

Water Resources

During the construction phase, the reconstruction of this segment of US-189 potentially represents an additional sediment source to Deer Creek Reservoir, Main Creek, and Daniel's Creek. The 1989 SEIS also describes a number of mitigation measures that would be applied to address these and other water quality issues (FHWA 1989a).

The Water Resources portion of this document addressing the Wildwood to Deer Creek State Park Segment of the reconstruction of US-189 contained additional analyses that examined impacts to Provo River water quality. A similar analysis would be performed for the Deer Creek State Park to Heber City Segment once a more refined design is developed to model water quality impacts to Deer Creek Reservoir and other water resources and propose mitigation. A SWP3 and construction BMPs would also be developed to reduce the potential impacts to water resources.

Vegetation and Wildlife

The 1989 SEIS describes the impacts to vegetation and wildlife resources, particularly big game, that would result from the reconstruction of this segment of US-189 (FHWA 1989a). In the coordination effort since then, the UDWR has continued to express concern with potential impacts to the mule deer and elk wintering range, such as the approximately 9 hectares (22 acres) of sagebrush habitat that would be affected above Island Bay, and has proposed mitigation measures such as strategically located big game crossings and fencing (Pederson 2000). Coordination would be continued with UDWR to locate and design mitigation measures to address potential impacts to big game as plans for this segment of US-189 progresses.

Threatened, Endangered, and Candidate Species

As previously noted, the reconstruction of this segment of US-189 would not affect any protected or sensitive species. Coordination with the USFWS would continue to address any future concerns with protected or sensitive species as reconstruction plans progress for the Deer Creek State Park to Heber City Segment of US-189.

Wetlands

The 1989 SEIS describes mitigation measures intended to mitigate impacts to wetlands and riparian resources, including a minimization of the area of wetland and riparian area impact and a wetland mitigation plan (FHWA 1989a). Box culverts were proposed for the two crossings at Daniel's Creek and Main Creek (FHWA 1989a), and further design would refine the specific details and mitigation requirements. Implementation of the SWP3 and construction BMPs would reduce indirect impacts to wetlands from sedimentation as described previously.

Fisheries

Potential minor indirect effects to Deer Creek Reservoir and Main Creek fisheries would be possible as a result of runoff associated with construction activities. However, as described previously, the implementation of a SWP3 and construction BMPs would help mitigate these impacts.

Land Use

The reconstruction of the Deer Creek State Park to Heber City Segment of US-189 would traverse a variety of private, State-owned, and Federally owned lands. Table 4-16 under the Wildwood to Deer Creek State Park Segment summarizes total ROW requirements for the Project from Wildwood to Heber City.

The Land Use impacts section for the Wildwood to Deer Creek State Park Segment discussed the general land use issues in the highway corridor as a whole. Similar to other portions of the highway, no new areas would have access for development as a result of the widening of US-189 from Deer Creek State Park to Heber City. Existing physical conditions in the Charleston area (soil limitations for septic systems) also lower the development potential of this part of the US-189 corridor. The Wasatch County General Plan supports the approved improvements to US-189 (Wasatch County Planning Commission 2000).

Visual Resources

As noted previously in this document, US-189 between the mouth of the canyon to its intersection with US-40 in Heber City has been designated as a State Scenic Byway, and designation as a National Scenic Byway is also being sought. Because high quality natural and scenic resources are criteria for National Scenic Byway designation, any changes to the visual environment from this Project would be in accordance with the existing visual quality of the corridor. Measures that would mitigate for impacts to existing visual characteristics of the highway corridor, including measures to ensure road cuts mimic existing landscapes and cut contouring are provided later in this chapter.

Recreational Resources

The 1989 SEIS describes the potential for impacts to recreational resources as a result of the proposed improvements to US-189, and suggests mitigation measures such as the inclusion of left-hand turn lanes, acceleration and deceleration lanes, and other measures to ensure safe access at major recreation facilities (FHWA 1989a). The description in this document of potential recreation impacts due to the proposed improvements from Wildwood to Deer Creek State Park discusses general recreation concerns, which also apply to this segment. Access to Deer Creek State Park would be maintained by the proposed highway improvements in this segment, and no other impacts to the Park would result from reconstruction outside the Park boundaries in the adjacent highway corridor.

Socio-economic Resources

Potential impacts to socio-economic resources from the proposed improvements to US-189 are described previously under the Wildwood to Deer Creek State Park Segment. As described previously, reconstruction of the highway would not allow any new areas to have access for development purposes.

Cultural Resources

As described previously, no impacts to significant historical, archeological, or paleontological resources are anticipated as a result of the proposed improvements to the Deer Creek State Park to Heber City Segment. However, coordination with the SHPO would occur once additional planning and design on this segment is initiated.

Noise

Studies of potential noise impacts from improvements to individual segments of US-189 have occurred as construction planning has proceeded. The original noise impact modeling performed in 1989 has been updated using more modern modeling software and traffic data, as described above for the Wildwood to Deer Creek State Park Segment. When the design for the Deer Creek State Park to Heber City Segment of US-189 nears completion, a noise analysis study would be conducted, utilizing updated software and traffic data as appropriate.

Air Quality

Studies of potential air quality impacts for segments of US-189 have been conducted as construction planning has proceeded. The original modeling performed in 1989 has been updated using more modern modeling software and traffic data, as discussed under the Wildwood to Deer Creek State Park Segment. When the design for the Deer Creek State Park to Heber City Segment nears completion, a new air quality analysis study would be conducted, utilizing updated modeling software and traffic and air quality data as appropriate.

TRAIL EXTENSION

This chapter presents the probable environmental consequences or impacts to the biological and human resources of the Project Area that would result from implementing the Trail Extension. The goals of these analyses are to ensure that the design parameters and environmental considerations are appropriate and to determine the potential for significant impact to the physical, biological, and social environments as a result of Project implementation. The direct, indirect, and cumulative impacts described are based on the existing conditions of each resource as presented in Chapter 3 for the Trail Extension.

Wherever possible, quantitative estimates of impacts were measured. Where quantitative assessments were not practicable or available, qualitative assessments were made. Potential direct and indirect impacts are discussed below under each affected resource component, and potential cumulative effects are disclosed in the Cumulative Effects section of this chapter. Impacts described in this chapter are based on preliminary design of the Trail Extension alternatives under consideration. During final design, efforts will be made to reduce or eliminate any such impacts. As noted previously, information located in the Highway Reconstruction portion of this chapter will not be duplicated in this portion.

Earth Resources

No foreseeable impacts to earth resources would occur as the result of implementing the Preferred Alternative, since all construction would take place on existing roads, with no new disturbances to geotechnically sensitive (potentially unstable) areas.

Water Resources

The proposed Trail Extension potentially represents an additional sediment source during the construction phase. The Preferred Alternative minimizes this potential, and would improve the existing condition as the result of protecting the existing gravel road system from erosion and sedimentation by paving.

The Preferred Alternative also avoids the major hillslope cuts of other alignments, which would create significant amounts of erosion through steepening slopes and loss of vegetation. The Alternative also avoids another likely source of sediment resulting from clearing a trail through vegetated areas.

Since the finished Trail Extension would be surfaced and sealed, any possible increase in sediment loads from trail construction would be mitigated. Avoidance of Trail construction in the Vivian Park to Ault's Bridge Segments would reduce the potential of impacts from additional constriction or confinements of the river channel, which is already confined by present infrastructure such as the highway and railroad. The 2002 Preferred Alignment would lie within the historical floodplain in some areas, but the presence of Deer Creek and Jordanelle Dams would generally preclude potential impacts from flooding.

Vegetation and Wildlife

Since the 2002 Preferred Alignment would utilize only existing roads, no impacts upon vegetation and wildlife resources would be expected from its implementation. Although the possibility of disturbance to some bird and other species due to increased human activity in the area does exist, the alignment avoids the sensitive riparian habitat of the most concern (Utah Division of Wildlife Resources 2002).

Threatened and Endangered Species

As noted above, the Preferred Alternative would not affect any protected or sensitive species in the Project Area.

Wetlands

As discussed in Chapter 2, the Preferred Alternative would avoid all wetland and riparian areas and thus not result in any impacts to those resources.

Land Use

General Land Use Impacts

The Preferred Alternative would traverse unincorporated private; Utah and Wasatch County; U.S. Department of Agriculture, National Forest Service; and Utah Department of Natural Resources, Division of Parks and Recreation (State Parks); lands and would require additional properties or easements to be acquired for this Project segment. Most property owners and other entities in the alignment have expressed willingness for use of their property for the Trail Extension, although some private parties remained concerned as to the potential for increased vandalism. The Preferred Alternative would include measures to prevent unauthorized vehicular access on the Trail Extension to minimize the potential for security conflicts.

Compliance with Project Area Land Use Plans

Current land use and management plans that apply to the Project Area include: the Wasatch County General Plan (2001-2016), Wasatch County planning, zoning, land use, and development codes (Wasatch County 1997), the Wasatch County zoning map (Wasatch County 1999), the Utah County

Master Plan (Utah County 1997), the Provo Canyon Scenic Byway Plan (BIO-WEST et al. 2000), and the Deer Creek Reservoir Resource Management Plan (Bear West 1998).

The Trail Extension up-canyon from Vivian Park has been addressed in all of the above plans and several list trails as a top priority. Trails that improve access to recreation resources are a criterion for designation as a National Scenic Byway, and it is anticipated that the Trail Extension development will aid in that designation.

Visual Resources

As noted previously in this document, the segment of US-189 between the mouth of the canyon to its intersection with US-40 in Heber City has been designated as a State Scenic Byway. Designation as a National Scenic Byway is also being sought. Since high quality recreational, natural, and scenic resources are criteria for the National Scenic Byway designation, it is anticipated that changes to the visual environment would be in accordance with the existing visual quality of the canyon. The Preferred Alternative would avoid any impacts to visual resources by avoiding construction in sensitive areas and utilizing existing roads.

Recreational Resources

The Trail Extension has been facilitated as mitigation and enhancement, and would provide improved recreational opportunities and facilities in and around Provo Canyon. The primary recreational change expected upon implementation of the Project would be the anticipated use of the recreational trail. Based upon public scoping and hearing comments (see Chapter 6), there exists considerable demand for such a facility, as evidenced by high current usage of the trails in the lower canyon and elsewhere in the general area. However, the trail will be located only on existing gravel roads and abandoned portion of the highway in areas of considerable existing use and will not open any new or sensitive areas. Additionally, trailheads associated with the Trail would benefit a variety of users in the canyon. Direct or indirect adverse impacts to developed, un-developed, or adjacent recreational facilities would not occur.

Socio-economic Resources

Adverse Socio-Economic impacts are not anticipated as a result of the Trail Extension. In fact, trails are generally associated with the overall perception of an improved quality of life in communities. As noted above, security concerns from some private property owners would be mitigated by the implementation of access controls. Owners of property near the Trail Extension would have their private access improved as the result of the Trail Extension and property values would be expected to increase.

Cultural Resources

In accordance with Section 106 of the NHPA, as amended, efforts have been made to consider the effect the Trail Extension would have on historic, archaeological, and paleontological resources. Based on inventories conducted by Sagebrush Archaeological Consultants (Weymouth et al. 1995), Brigham Young University's Office of Public Archaeology (BYUOPA 1995, 2001), and Alpine Archaeological Consultants (Reed 2001), UDOT and FHWA determined that four of the ten identified properties in the general vicinity of the Trail are actually within the APE for the Trail Extension. These four properties have also been determined to be eligible for the NRHP as defined by 36 CFR 60.4 (BYUOPA 1989, 2001; Southworth 1995; Skinner 2000) (Table 4-19).

Table 4-19. Properties within the Area of Potential Effect (APE) of the Provo-Jordan River Parkway Trail Alignment.

SITE NUMBER AND NAME	SITE TYPE	ELIGIBILITY	ELIGIBILITY REFERENCE
42WA113: Fisherman's Bridge	Historic	Eligible	BYUOPA 1989
42WA112: Heber Valley Historic Railroad (HVHR)	Historic	Eligible[a]	Southworth 1995
DC6: Deer Creek Reservoir Dam Complex	Historic	Eligible	Southworth 1995
DC5: Provo River Timber Stringer Bridge	Historic	Eligible	Southworth 1995

[a] The eligible segment of theHeber Valley Historic Railroad (HVHR) is located between roadway station 18+000 (Wildwood) and 22+500 (immediately down-canyon from the historic railroad overpass).

Utah Department of Transportation and FHWA have determined that the Trail Extension would have no effect on the Fisherman’s Bridge (42WA113), the HVHR (42WA112), the Deer Creek Reservoir Dam Complex (DC 6), or the Provo River Timber Stringer Bridge (DC 5). However, the 2002 Preferred Alignment from the highway would have adverse effects, as described under the Highway Reconstruction section of this chapter. Therefore, despite the Trail Extension having no effects on cultural resources in the canyon, a finding of adverse effect has been determined for this Project in general. These determinations and findings are detailed in the Section 4(f) analysis included in Chapter 5.

The Utah State Historic Preservation Office has concurred with these determinations through a new MOA (Appendix G). Although the ACHP participated in the MOAs previously executed for this Project in 1989 (FHWA 1989b) and 1995 (UDOT 1995), the ACHP declined to participate in the new MOA for the Wildwood to Deer Creek State Park Segment. No paleontological resources within the APE would be affected by the Project.

COMBINED CONSIDERATIONS

Direct and Indirect Impact Summary

Table 4-20 compares direct and indirect impacts for the 1989 SEIS Alignment, the 2002 Preferred Alignment, and the No-Action Alternative for the Wildwood to Deer Creek State Park Segment. Since the potential impacts of constructing the Deer Creek State Park to Heber Segment are rather non-specific under the current conceptual design, they are not summarized in this table. Although current zoning laws discourage growth within the canyon itself, either alignment would indirectly contribute to the residential, commercial, and industrial growth of the Utah and Heber Valleys.

Cumulative Effects

Introduction

Cumulative effects consist of the effects on the environment resulting from the incremental impact (for any given environmental resource) of the proposed Project when it is added to other past, present, and foreseeable future projects and actions, regardless of who carries out the other action (40 CFR Part 1508.7). A proposed action must be far enough along in the planning process that its implementation is reasonably foreseeable. For this analysis, a reasonably foreseeable action is one that has undergone a substantial amount of planning and concept development, and is actually expected to occur, whether or not it has obtained local, State, or Federal approval or funding.

Past, Present, and Reasonably Foreseeable Future Activities Considered

Specific projects with the potential to cumulatively affect the resources evaluated for the Wildwood to Deer Creek State Park Segment of this Project are identified in Table 4-21. These projects are further described in the narrative following the table. Some resources would be affected by several or all of the described activities (Figure 4-3), while others could be affected very little or not at all.

The Preferred Alternative's incremental contributions to potential resource impacts are included in the cumulative effects discussion for each resource.

U.S. Highway 40 (US-40) Reconstruction between Park City and Heber City (Past)

The reconstruction and widening of U.S. Highway 40 (US-40) between Park City and Heber City was sponsored by UDOT and FHWA, and was completed in fall 2000 (UDOT 2000a).

Table 4-20. Summary of Anticipated Impacts from the Wildwood to Deer Creek State Park Segment.

RESOURCE COMPONENT	1989 SEIS ALIGNMENT	2002 PREFERRED ALIGNMENT	NO ACTION
Earth Resources	Excavation and transport of fill materials	Excavation and transport of fill materials	None
Water Resources	Potential increase in erosion during and following construction	Potential increase in erosion during and following construction	Increased pollution from increased traffic
Vegetation and Wildlife			Increased wildlife disruption from increased traffic
Ground Disturbance that Could Lead to Potential Spread of Noxious Weeds	17.87 hectares (44.15 acres)	29.61 hectares (73.16 acres)	
Important Habitat	16.11 hectares (39.81 acres)	9.09 hectares (22.46 acres)	
Threatened and Endangered Species: Bald Eagle Roosting Habitat	3.36 hectares (8.30 acres)	None	
Wetlands	0.62 hectare (1.54 acres)	0.77 hectare (1.90 acres)	None
Fisheries: Riverine Habitat	0.34 hectare (0.84 acre)	0.07 hectare (0.17 acre)	None
Land Use	0.40 hectare (1.0 acre) of prime and unique farmlands.	No impacts to any important farmlands.	None
Visual Resources	Greater impacts to Provo River and its associated riparian areas; four new bridges over the Provo River.	Greater cut and fill heights and lengths, highway intrusion into the visual environment of the Canyon Meadows community.	None
Recreation Resources	Improved highway access to developed areas. Impacts to 1.09 hectares (2.70 acres) of land managed by Deer Creek State Park but not used for recreation.	Improved highway access to developed areas. Impacts to 19.18 hectares (47.40 acres) of land not included in Deer Creek State Park and restricted from recreation.	Greater use as a result of increased traffic
Socio-economics	Greater traffic delays during roadway construction; impacts to the HVHR tracks.	Highway intrusion into the Canyon Meadows community.	Increased disruption from higher traffic volumes
Relocations	Two residential relocations.	0 residential relocations.	
Cultural Resources	Impacts two historic residences and one archaeological site.	Impacts one historic dam complex and one prehistoric site.	None
Section 4(f) Properties	Impacts two historic residences and land managed by Deer Creek State Park but not available for recreation.	Impacts one historic dam complex, one prehistoric site, and land managed by Deer Creek State Park but not available for recreation.	
Noise	Temporary construction-related noise.	Temporary construction-related noise.	Higher levels due to increased traffic
Air Quality	Temporary construction-related impacts.	Temporary construction-related impacts.	None
Truck Access	No impacts.	No impacts.	None

Table 4-21. Past, Present, and Reasonably Foreseeable Future Activities Considered.

CUMULATIVE ACTION	PAST	PRESENT	FUTURE
US-40 Reconstruction between Park City and Heber City	X		
Canyon Meadows Development	X	X	X
Jordanelle Dam Construction	X		
University Avenue Projects in Provo: • Widen from I-15 to 900 South • Rebuild from 500 South to 1250 North • Rebuild from 1250 North to 1650 North • Widen from 1650 North to Mouth of Provo Canyon	X		
800 North Street Improvements from I-15 to Olmstead Junction, Orem	X		X
Olmstead Diversion Pipeline Reconstruction		X	X
I-15 Reconstruction in Salt Lake County	X	X	X
I-15 Reconstruction in Utah County	X	X	X
800 North Street / University Avenue Signal, Orem and Provo	X		X
Soldier Hollow Access Roads	X	X	
Deer Creek Dam Foundation Repair			X

Canyon Meadows Development (Past, Present, and Future)

The portion of the Canyon Meadows development regulated by the CMHA presently consists of approximately 25 homes; the CMHA holds permits for six more homes in the immediate future. The original developer, Mr. Arden Engebretsen, now represents New Canyon Meadows and owns 13 lots in the existing development and has additional acreage around the development. A Special Services District has been formed to facilitate additional utility development. Thus the development is expected to continue. The actual number of new units that will be developed is difficult to quantify because of variability in permitting processes, zoning approvals, and geotechnical studies, and pending litigation between the county, CMHA, and developer.

Jordanelle Dam Construction (Past)

Construction of the Jordanelle Dam project was completed in 1993 as part of the Central Utah Project. The project was sponsored by the Central Utah Water Conservancy District and BOR. Considerable developable property exists at various locations around the reservoir. Development has recently started at various locations around the dam, and could substantially increase Wasatch County's current population of about 15,000. As discussed under Land Use, Wasatch County has implemented very stringent controls on these developments to regulate and mitigate environmental impacts.

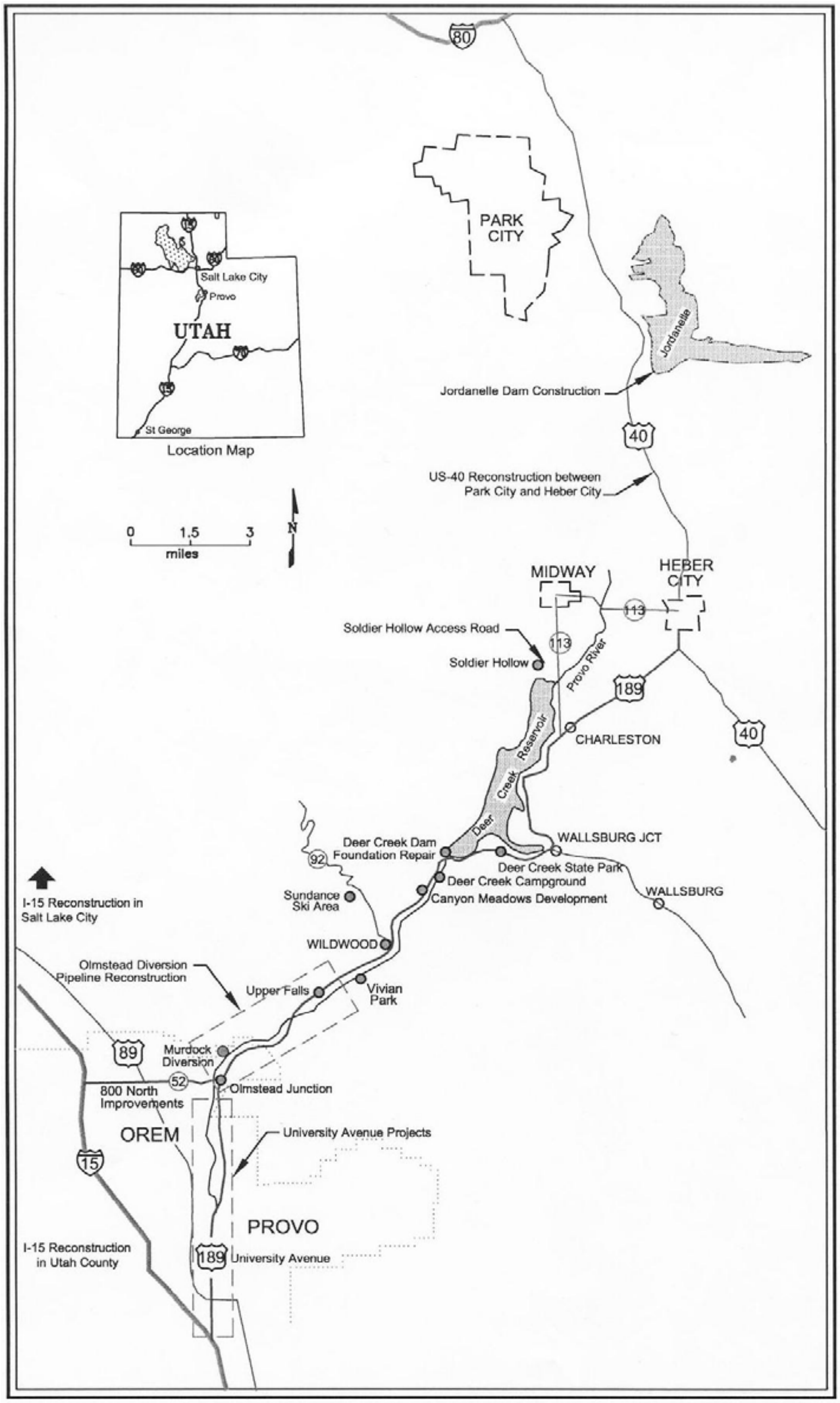

Figure 4-3. Past, Present, and Anticipated Future Locations of Activities Contributing to Cumulative Environmental Impacts in the the Provo Canyon Highway Improvement Project Area (Project Area).

Full build-out has been set by the County at about 18,000 people or about 7,000 housing units and is expected to take 20 or more years.

University Avenue Projects in Provo (Past)
A number of projects have been completed along University Avenue in Provo and considered in this cumulative effects analysis. All were sponsored by UDOT and the City of Provo, and consisted of reconstruction, some widening, and improved entrance and exit facilities.

800 North Street Improvements from Interstate 15 (I-15) to Olmstead Junction, Orem (Past and Future)
The UDOT improved 800 North as part of this original Project and is presently initiating concept development and developing the design for further improvements along the corridor.

Olmstead Diversion Pipeline Reconstruction (Present and Future)
Approximately 10.5 kilometers (6.5 miles) of this pipeline will be reconstructed, including some portions on the Uinta National Forest. The project is sponsored by the Central Utah Water Conservancy District and is currently underway.

Interstate 15 (I-15) Reconstruction in Salt Lake County (Past, Present, and Future)
A major portion of I-15, from 9000 South to 600 North through Salt Lake City, has been reconstructed. Environmental documentation and preliminary design for further reconstruction of I-15 north from 600 North to Davis County and beyond has been initiated, but not finalized. Additional UDOT planning studies for I-15 south to the Utah County line are also underway.

Interstate 15 (I-15) Reconstruction in Utah County (Past, Present, and Future)
For a distance of approximately 6.4 kilometers (4 miles) between Center Street in Provo and Springville, I-15 has been reconstructed and widened to six lanes. New access to I-15 was provided from 1860 South (Novell Complex), and structural work was done on Provo Center Street, 600 South, and 920 South. The project was sponsored by UDOT and FHWA, and completed in 2002. Additional UDOT planning studies for I-15 through Utah County are currently underway.

800 North Street / University Avenue Signal, Orem and Provo (Present)
A new traffic signal at University Avenue and 800 North was completed in 2001. The project was developed to promote safety, since the existing interchange is functionally obsolete. The project was sponsored by UDOT.

Soldier Hollow Access Roads (Past)
The UDOT widened three Soldier Hollow access roads and constructed one other for State Parks in 2001. These roads completed the Biathalon Olympic Venue and will be turned over to State Parks following the Olympics.

Deer Creek Dam Foundation Repair (Future)
Portions of the foundation of Deer Creek Dam require some densification and repair. The BOR has defined what level of repair is required and intends to initiate this work late in 2003 prior to the placement of the new highway across the dam.

Cumulative Effects of the 2002 Preferred and 1989 SEIS Alignments
Potential cumulative effects of the 2002 Preferred and 1989 SEIS Alignments are identified below. Selecting and constructing either alignment, in conjunction with other cumulative actions, could result in the following:

- No Impact - Nothing would change because of the construction of the selected alignment in conjunction with other past, present, and foreseeable future actions;

- Maintenance of Current Trends - Selecting and constructing a given alignment would contribute to existing resource trends along with other actions;

- Beneficial Impact - A resource would benefit from construction of a selected alignment in conjunction with other past, present, or foreseeable future actions; or

- Minor, Moderate, or Substantial Adverse Impact - A resource would be adversely affected by construction of a selected alignment in conjunction with other past, present, or foreseeable future actions.

Earth Resources
The historically unstable geologic characteristics of the Project Area, particularly near the Hoover Slides, in conjunction with previous construction and other activities in the area (highway construction and maintenance, Canyon Meadows development, etc.), could be potentially exacerbated by the Project. However, analyses have indicated that implementation of the 2002 Preferred Alignment would minimize that risk by moving the highway away from the toe of the Hoover Slides. The 1989 SEIS Alignment would result in similar impacts, but it would cross or impact a greater number of active slides in the Project Area. Construction of either alignment would result in minor incremental increases to cumulative impacts on earth resources in the Project Area, with no anticipated cumulative impacts beyond the Project Area.

Water Resources
Past actions within the upper Provo River watershed, such as the construction of Jordanelle and Deer Creek Reservoirs, have significantly altered the hydrology and ecological functions of the Provo River. Construction of either the 2002 Preferred or 1989 SEIS Alignment would potentially add a moderate incremental adverse impact to Provo River water quality during construction, as have nearly all other major actions within the watershed. Since Provo River water in Deer Creek Reservoir constitutes a major component of the water supply for much of Utah's highly populated Wasatch Front, any impact to water quality could have considerable incremental effect well beyond the watershed. Overall impacts to water resources under the 1989 SEIS Alignment would be greater because of its closer proximity to the Provo River. However, the appropriate use of BMPs, as

detailed for the 2002 Preferred Alignment under the Water Resources discussion above, would eliminate such effects and provide a net beneficial impact within the Project Area, throughout the downstream watershed, and beyond.

Vegetation and Wildlife

Cumulative impacts to vegetation and wildlife would be similar under each alignment and could extend well beyond the immediate Project Area. Both the 2002 Preferred and 1989 SEIS Alignments would add a minor, adverse, incremental impact to vegetation and wildlife resources in the Project Area. These would include some general vegetation and habitat loss, wildlife displacement, possible disruption of wildlife migration and wildlife mortality, and the potential for increased noxious weeds from land disturbance. As previously noted, because the haul road for the previous segment of the Project has already been constructed, many of the direct impacts to vegetation and wildlife under the 2002 Preferred Alignment have already occurred. Since the Project is not expected to affect land use or development either within or beyond the Project Area, no cumulative impacts to wildlife and vegetation from growth and development are expected as the result of implementing the Project.

Wetlands

Impacts to wetlands from construction of either the 2002 Preferred or 1989 SEIS Alignment would incrementally add to those from other past, present, and planned activities in the area. However, all wetland impacts would be mitigated, and thus no net change would occur. Over the entire Project Area, a net gain in wetland area would be achieved as a result of the additional mitigation development at the Bullock site. Since additional growth and development is not expected either within or beyond the Project Area as the result of implementing the Project, no cumulative impacts to wetlands are anticipated.

Fisheries

Fisheries resources in the Project Area and throughout the Provo River watershed are considered valuable. Currently, many locations are considered critical Class I habitats by the UDWR. Construction of the 1989 SEIS Alignment, because of its close proximity to the Provo River, would add moderate cumulative impacts to fisheries but would not affect the Deer Creek fishery. Construction of the 2002 Preferred Alignment would reduce the potential for increased cumulative impacts to the Provo River fishery because the roadway would be relocated away from much of the river channel, and would provide a net benefit to the Deer Creek fishery as a result of the planned restoration of lower Deer Creek. Therefore, no cumulative effects from this Project would be expected to result within the Project Area or beyond.

Land Use

Cumulative impacts to land use from construction of either the 2002 Preferred or 1989 SEIS Alignment would include an incremental adverse loss of and encroachment into open space within the Project Area. Although some additional growth of the Canyon Meadows development (and possibly a few other areas) would be expected, new zoning restrictions by Wasatch County would significantly restrict growth within the Project Area (Appendix F).

Cumulative impacts from additional residential and other development beyond the Project Area are certainly a concern relative to a wide range of environmental and human resources. As noted above, it is fortunate that such impacts are very minimal and have been largely mitigated by appropriate land use planning. Wasatch and Utah Counties use their zoning and permitting processes to minimize impacts to sensitive habitats. Since those portions of the general highway improvement project in Utah County have been completed for some time (see Chapters 1 and 2), Wasatch County is the primary local government and planning entity influencing such concerns. As noted previously, Wasatch County recently implemented a particularly effective protective zone (P-160) to protect sensitive environmental areas and resources (Appendix F). As indicated on the Wasatch County Zoning Map (Appendix E), this protective zone covers all of the immediate Project Area and the great majority of other sensitive areas in the county. Thus, it will protect against future direct impacts, as well as long-term indirect and cumulative effects from this and other projects. Local plans and zoning will help define future conditions in the area.

Visual Resources

Nearly all past and present activities in the Project Area and the surrounding environs, including the existing highway, have impacted the area's visual resources relative to its natural condition. The 2002 Preferred Alignment would incrementally add to these impacts because of the presence of the larger highway facility and associated cuts and fills. However, the design approach and mitigative measures planned, including moving the highway away from the river and the further restoration of Deer Creek, would provide visual resource improvements to the existing situation. Construction of the 1989 SEIS Alignment would have moderate, adverse impacts on the visual resources of the Project Area. No incremental cumulative impacts to visual resources outside of the Project Area are anticipated.

Recreation Resources

Long-term cumulative effects on recreation resources within Provo Canyon would include both adverse and beneficial impacts. The new highway would provide improved access to multiple existing recreational opportunities within the canyon. However, the benefit of improved access would be anticipated to increase visitor use. Increased visitor use may result in some resource degradation and adversely impact the recreational experience of those who seek solitude. Similar incremental cumulative impacts of a minor scale could affect recreation resources outside of the Project Area as the result of improved traffic operations and safety through the highway corridor.

Socio-economics

In conjunction with other past, present, and reasonably foreseeable future actions, some socio-economic impacts could be expected from the construction of either the 2002 Preferred or 1989 SEIS Alignment. Some travelers and recreationists (see above) within the Project Area and in areas beyond may experience incremental adverse socio-economic impacts from traffic disruption, increased local traffic, and construction activities. The Project would not have disproportionately high or adverse impacts on minority or low-income populations or communities.

Cultural Resources

Construction of either the 2002 Preferred or 1989 SEIS Alignment, considered in terms of past, present, and future projects, would result in some adverse cumulative impacts to cultural resources caused by the loss of or impact on the overall archaeological and historical resources of the Project Area.

Noise

Past actions associated with previous highway development, including both construction and use, have contributed to a scenario where noise in the canyon is elevated above a natural condition. Implementation of either alignment would result in site-specific changes to noise levels throughout the Project Area, with some sites experiencing a slight increase and others a slight decrease. Based on the FHWA NAC and results predicted by FHWA's TNM traffic noise model, the Project Area is expected to experience a minor incremental increase in noise levels.

Air Quality

According to the Provo Canyon Traffic Analysis (Fehr & Peers 2000), implementation of the 2002 Preferred Alignment would be expected to induce an increase in traffic volumes by approximately 6 percent. Since increased traffic volumes and vehicle emissions are usually associated with degradation of air quality, the 2002 Preferred Alignment can be expected to add to the cumulative impacts to air quality resulting from past and future actions within Wasatch County. Similar cumulative impacts to air quality would be anticipated under the 1989 SEIS Alignment. This project is included in a conforming Statewide Implementation Plan, which looks at air quality in the area as a whole and considers the impacts of a variety of major projects on future air quality.

Environmental Short-term Uses Versus Long-term Productivity

The short-term uses of the environment versus preserving its long-term productivity relates to converting the natural productivity of the land, viewed as renewable use of resources, to some developed use that has a relative short economic life and is a short-term use. For the Wildwood to Deer Creek State Park Segment, the long-term productivity that would be lost would be the current wetland and wildlife productivity within the ROW. These would be replaced by the relative short-term use of the land for the construction of the widened and realigned highway. This short-term use of the environment would generally be consistent with local land use and transportation plans that are based on improving safety. Therefore, the proposed Project is consistent with the maintenance and enhancement of long-term productivity as defined by local governments.

Irreversible and Irretrievable Commitment of Resources

Irretrievable impacts are those involving the use of natural or human resources that could not be regenerated or recovered once an alternative was implemented. Irretrievable impacts include losses of production or use of renewable natural resources. Irreversible impacts would occur where the implementation of a project would result in long-term or permanent changes to the ecosystem. Irreversible impacts include non-renewable resources, such as cultural resources, and those factors that are renewable only over long periods, such as soil productivity. Irreversible commitments also include the loss of future options.

There would be some irretrievable losses to soil hydrologic function and site productivity, vegetation, and wildlife habitat where the realigned highway would be constructed. Irretrievable impacts would also include the consumption of fossil fuels, the use of materials for highway construction, human labor, and the expenditure of funds for construction of the Project. In addition, labor and natural resources would be used in the fabrication and preparation of construction materials used. These materials are generally irretrievable. However, they are not in short supply, and their use would not have an adverse effect on the continued availability of these resources.

Irreversible commitments could include temporary disturbance of wildlife and their habitat in localized areas that could result from changed vegetation conditions. Where the new alignment would be constructed there would be some irreversible commitment of soil and land use during the time period that the land is used for the highway.

These resource commitments are based on the premise that nearby residents, the State, and the region would benefit from an improved transportation system. These benefits would include improved accessibility, increased safety, and savings in time, all of which are anticipated to outweigh the resource commitments.

Mitigation Measures

Many potential impacts have been eliminated or reduced by adjusting the proposed action and/or avoiding sensitive resources. The remaining impacts associated with Project construction and operation will be minimized by adhering to the current UDOT standard specifications for road and bridge construction and a variety of Project-specific design specifications. The 1989 SEIS included a variety of mitigation measures that have been incorporated here, as appropriate, and additional measures specific to the 2002 Preferred Alignment are listed below by resource.

Construction activities will be supervised by the UDOT Project Engineer, who will have the authority to enforce adherence to these measures. An independent environmental consultant will monitor mitigation commitments during construction, in coordination with the Project Engineer. The CAT will continue to meet during the design and construction of the Project to provide input and transmit Project information to their constituents.

Earth Resources

- Reduce risks and anticipate long-term maintenance in the area in the final geotechnical design. Control rock fall during construction and control rock fall for long-term maintenance.

- Explore use of deep drainage systems, where feasible, to maintain stability.

- Minimize the use of temporary or permanent cuts to avoid reduction in up-slope stability.

- Install additional exploration and instrument monitoring prior to construction to quantify subsurface conditions and design factors for implementation in the final design.

- Incorporate aesthetically appropriate rock-cut treatments into the design to maintain natural appearance to the extent possible. Include qualified landscape architect input to soil shaping and rock-cut designs.

- Minimize risk to the public during high avalanche and snowslide periods by considering passive avalanche control methodologies, such as snowsheds, starting zone structures, or surface alterations, and a continuation of current avalanche hazard forecasts and active control.

Water Resources

- Obtain a Utah Pollution Discharge Elimination System (UPDES) General Storm Water Discharge Permit. As part of the requirements of the UPDES permit, develop a SWP3 and incorporate it in the final design plans of the Project. Also, submit a Notice of Intent to the Utah Department of Environmental Quality, Division of Water Quality, prior to commencing construction.

- Implement BMPs recommended for water-quality protection and erosion control in the *Provo Canyon Scenic Byway Corridor and Watershed Management Plan* (BIO-WEST et al. 2000), and adhere to UDOT's current specifications for road and bridge construction and to the BMPs discussed under Water Resources in this chapter. Best management practices provide mitigation techniques to control erosion and sediment. Short-term BMPs will be implemented to deal with construction erosion and sediment generation, and long-term BMPs will be included in the design to control any potential increase in erosion after construction and restoration / revegetation have been completed. Final design plans will ensure implementation of both construction and post-construction BMPs (i.e., erosion and sediment control) such that net increases in sediment yield will be minimal.

- Include a comprehensive SWP3 that entails various forms of runoff management and surface protection (for example: silt fence, straw bale barriers, protected ditches, sediment traps, erosion blankets), along with adequate inspection and maintenance of BMPs with active construction BMPs.

- Include prompt and successful revegetation of all slopes under 50 percent (1 vertical to 2 horizontal) where practicable and rock-lined grass swales to slow water and filter sediment, permanent sediment traps, etc., with long-term BMPs. Proper removal and disposal of detained sediment will also be included in long-term BMPs.

- Relocate the new highway near Little Deer Creek to the north, and remove the existing fill and culvert. A new fill slope and culvert have already been constructed north of the existing highway. Restore Little Deer Creek from the outlet of the new culvert to the Provo River.

Vegetation and Wildlife

- Develop an appropriate landscaping and revegetation plan as part of the highway design.

- Emphasize use of native species.

- Minimize areas of disturbance in all roadway sections to reduce the potential for noxious weed invasion through implementation of the UDOT Special Provision on Invasive Weed Control. Ensure that methods to control noxious weeds are implemented before seeding, per UDOT's current standard specifications for road and bridge construction.

- Revegetate at the earliest possible date all disturbed areas not occupied by Project facilities. This will stabilize disturbed soils, minimize erosion, and enhance the productivity and aesthetics of the disturbed areas. Revegetate using UDOT-approved seeding methods. Coordinate the revegetation effort with the Project landscaping plans.

- Revegetate in conjunction with erosion control. Protect exposed soil from erosion; if mulch is applied, use only certified weed-free straw or hay, with certification of a weed-free source from the county extension agent for the county in which the hay or straw is grown.

- Develop and implement a monitoring program that would ensure revegetation and landscaping success.

- Install deer-proof fencing where necessary in coordination with the UDWR.

- Construct big game crossings at or just east of the main entrance to Deer Creek State Park, at the Wallsburg turnoff, and in the vicinity of Macafee Hill.

- Minimize disturbance of the cottonwood trees between Wildwood and Deer Creek Dam used by bald eagles for winter roosting. Monitor these areas for bald eagle winter roosting use and coordinate the results and any construction constraints with the USFWS prior to any winter construction. Do not remove large cottonwoods or any other snag trees unless absolutely necessary.

- Conduct golden eagle nest surveys throughout the entire Wildwood to Deer Creek State Park Segment immediately prior to construction. Coordinate the results of the surveys and any construction constraints with the USFWS prior to construction.

- Avoid destruction of riparian and wetland habitats beyond that necessary for careful construction and actual highway placement. No structures or facilities will be placed in the river. Replace loss of wetland habitats according to Section 404 permitting obligations. Construct retaining walls to minimize indirect effects to habitats along the river. Avoid impacts to the river bank for at least 2.44 meters (8 feet) from the river's edge to prevent impacts to the river otter (*Lutra canadensis*).

- Conduct early springtime, pre-construction Columbia spotted frog (*Rana luteiventris*) surveys of any Project Area wetlands that are suitable habitat and would be impacted by construction. Provide survey results to the UDWR (Central Region) and the USFWS.

Wetlands

- Construct the remaining portion of the Little Deer Creek restoration site (0.53 hectare [1.3 acres]) as part of the Wildwood to Deer Creek State Park Project. Anticipated wetland impacts from the Wildwood to Deer Creek State Park Segment of the Project were permitted previously by the Corps (Permit No. 199450024) and have been mitigated at the wetland mitigation site (Bullock property) included in the Upper Falls to Wildwood Segment mitigation. Monitoring of the site will continue in accordance with the permit. The portion of the Deer Creek restoration site that has already been created (0.28 hectare [0.70 acre]) provides stream channel and riparian mitigation, but it does not provide wetland mitigation.

- Maintain the 2.44-meter (8-foot) buffer between the ordinary high water mark of the Provo River and any construction disturbance as specified in the Corps permit.

Fisheries

- Take measures to minimize sediment entering the Provo River or its tributaries (see discussion under Water Resources above).

- Implement construction procedures that minimize silt production, especially during fish spawning and brooding seasons.

- Establish staging areas only outside riparian zones. Require protection against spills or other disturbances. Require the construction contractor to dispose of construction contaminants such as oil, fuel, and chemicals outside the canyon in accordance with all pertinent laws and regulations.

- Construct retaining walls where required to minimize roadway impacts to the river and fish habitat.

- Mitigate the new fill embankment-related loss of trout habitat in Little Deer Creek by completing restoration between existing US-189 and the Provo River as follows:

- Increase instream cover for resting, hiding, and shelter to 10 percent in the 128-meter (420-foot) reach of Little Deer Creek below the highway (resulting in an increase of 46 trout HUs in Little Deer Creek) by (1) regrading and planting banks with willows, dogwoods, or other perennial macrophytic shrubs; and (2) installing structures designed to provide cover for trout, such as cabled trees and logs or boulder clusters.

- Increase the length of Little Deer Creek by restoring the section of stream that is currently in culvert under the existing highway and realigning the channel to include several meandering bends between the culvert outlet of the proposed highway alignment and the Provo River. An increase in length of 100 meters (330 feet) of channel with comparable habitat quality will result in a 1:1 replacement of stream impacted by the proposed highway alignment.

- Modify the existing culvert beneath the HVHR crossing of Little Deer Creek to provide passage for trout and access to areas upstream for spawning. The new culvert in place over Deer Creek for the 2002 Preferred Alignment was designed to provide passage for adult trout that utilize Little Deer Creek for spawning.

Land Use

- Minimize impacts to current land uses through coordination between UDOT and BOR, Wasatch County, and area utilities.

Visual Resources

- Implement Context Sensitive Solutions, a recent UDOT/FHWA initiative to develop designs based on environmental/aesthetic sensitivity, to the Project. Consider design exceptions as needed to reduce impacts.

- Mitigate visual impacts resulting from the Preferred Alternative as described in the 1989 SEIS:

  - Minimize clear zone widths and align the highway as far from the Provo River and Deer Creek Reservoir as possible.

  - Provide turnouts and parking at scenic locations and recreation areas.

  - Incorporate aesthetically appropriate rock-cut treatments into design to maintain natural appearance to the extent possible. Include qualified landscape architect input to soil shaping and rock-cut designs.

- Incorporate detailed landscaping and revegetation plans in the Project design. Revegetate soil cut slopes and embankments with native species.

- Coordinate closely with canyon residents and users to minimize visual impacts.

Recreation Resources

- Revegetate cut and fill slopes to soften visual scars of highway construction. Plant landscape screenings along key locations of the route to reduce visual impacts to recreationists.

- Provide left-turn, acceleration, and deceleration lanes at major recreational facilities as appropriate.

- Provide recreation and fishing access at the base of Deer Creek Dam in coordination with BOR, Provo River Water Users Association, and appropriate agencies. Consider location of restroom facilities near recreational areas.

- Plan and design the recreational trail to enhance canyon use by the public.

Socio-economics

- Implement measures inherent in FHWA's and UDOT's policy of compensation for ROW acquisition to alleviate the primary socio-economic concerns of landowners.

- Adhere to Federal and State relocation policies to provide necessary compensation to land owners.

- Minimize disruption to the traveling public during construction with traffic control planning and operations.

Cultural Resources

- Conduct a Historic American Engineering Record Survey to minimize the effects of impacts to the Deer Creek Reservoir Dam complex.

- Implement a data recovery plan for eligible prehistoric site 42WA42, and consult with the Utah State Historic Preservation Office and ACHP regarding the treatment of unidentified archaeological sites discovered during Project construction.

Noise

- Minimize construction noise through the application of noise-abatement measures contained in UDOT's current standard specifications for road and bridge construction. All contractors involved in construction activities will be required to adhere to these measures.

Air Quality

- Implement UDOT standard fugitive dust control measures during all construction activities.

Photo 4-1. Simulated Daytime View of US-189 from Canyon Meadows Area.

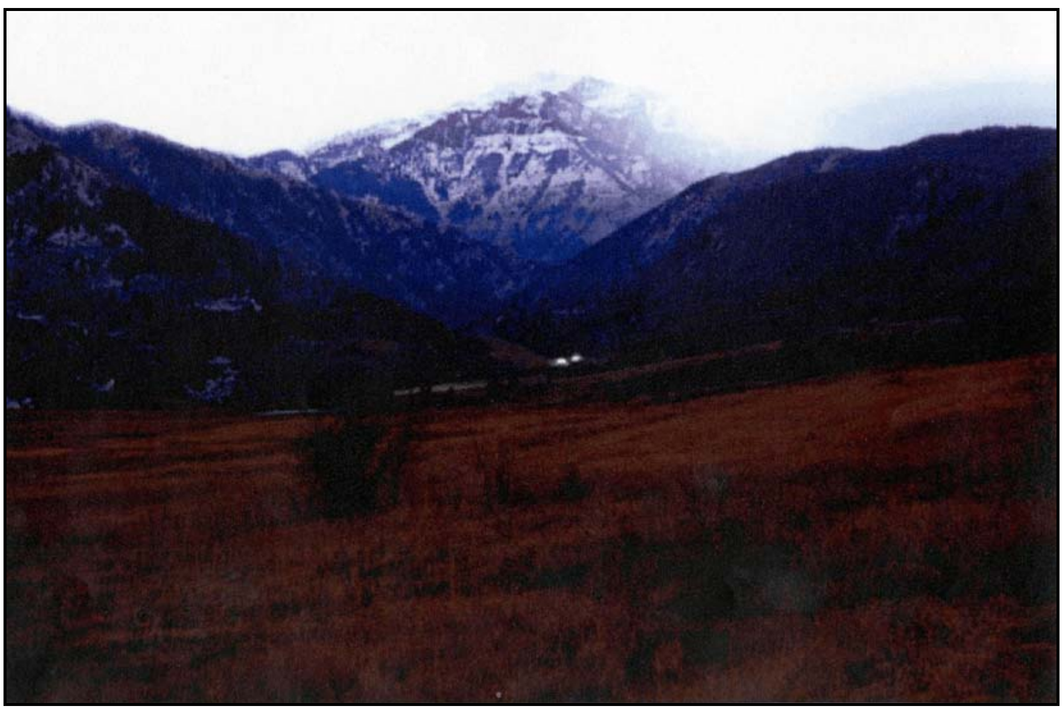

Photo 4-2. Simulated Nighttime View of US-189 from Canyon Meadows Area.